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TO ADVERTISERS

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Monday noon to assure publication in that week's issue.

NOTES ON INDUSTRIAL ELECTROCHEMISTRY.

The excellent series of notes on industrial electrochemistry and electrometallurgy, by John B. C. Kershaw, which has been appearing in the ELECTRICAL REVIEW for some months, will soon be brought to a close. Mr. Kershaw has command of exceptional facilities for getting information regarding both the methods in use and the success which has attended their application. He gives in this series a complete review of the many applications of electrochemistry, both in this country and in Europe. Changes and improvements in these industries have been taking place with great rapidity in recent years, and a review which brings our information on these matters up to date can not fail to be of value to all interested.

PRACTICAL WIRELESS TELEGRAPHY.

The London *Times* for March 30 published two messages of over one hundred words which it had received from its New York correspondent, sent from America by the Marconi wireless system. It was also announced in the same paper that arrangements had been made with the Marconi company for transmitting news day by day between the old world and the new by the Marconi system.

Another Stage in Application.

This announcement marks another stage in the practical application of wireless telegraphy. It was only fourteen months ago that the first faint transatlantic signal was received by Marconi at Signal Hill, Newfoundland. A little more than one year later a message was successfully sent across the Atlantic from Glace Bay, Nova Scotia. About two months later the Wellfleet Station, at Cape Cod, was tested successfully, and now, with the lapse of another two months, the company has begun the regular sending of news by this new system. It is not yet ready, however, to begin commercial operation, but hopes to do so shortly.

Marconi's Brilliant Record.

But a few years ago Marconi was known only as an enthusiastic experimenter in the new field of wireless transmission of signals. His unwavering faith brought the necessary capital to his aid and enabled him to make a record for developing and applying a new method such as has seldom been equaled.

STUDENTS OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

As already announced, the American Institute of Electrical Engineers has arranged to extend certain privileges to those who are regularly pursuing study in electrical engineering. The regulations under which these privileges are extended may be found elsewhere in this issue, and, as will be seen, are very liberal. These privileges may be enjoyed by those students who are following correspondence courses or studying under a private tutor, as well as by those in regular attendance at some technical school. The success attending President Scott's efforts in establishing local sections has been so marked, and the growth of the Institute has been so rapid since renewed interest was awakened, that doubtless many students will gladly welcome this opportunity to identify themselves with the Institute upon such liberal terms.

A Good Step.

The move seems to be a wise one, as it will not only benefit the students, but, by interesting them in the work of the Institute, promote its interests by ensuring it a large and enthusiastic membership in the future.

IMPROVED RAPID TRANSIT FACILITIES FOR NEW YORK CITY.

On the first day of this month the Interborough Rapid Transit Company took over the management of the Manhattan Elevated Railway. The same company will operate the subways now in course of construction in New York city, and will thus control the most important transportation systems in Greater New York. It is to be expected that the coordination of the two systems—the elevated and the subway—will bring about decided improvements in the transit facilities of the city. The two systems will certainly work together better for the same end than if their interests conflicted.

The Interborough Rapid Transit Company has, in the person of Mr. E. P. Bryan, a capable and experienced general manager. Mr. Bryan, who is an old-time telegraph operator, has had much experience in large railway management. The city, as well as the company, is to be congratulated on having such an able official in charge of this important work.

REAL AND IMAGINARY INVENTIONS.

In times past the lot of the student of what we may for the moment call science was often far from pleasant. Science itself as it then existed was a strange mixture of truth and speculation, and there was much difference between the men who spent their time in the pursuit of further knowledge of things real and unreal. Certain of these wise men were undoubtedly moved by a desire for truth. Others were probably seeking knowledge of the unknown in order that its possession might assist them in drawing money from the credulous. Others again, no doubt, pretended to have knowledge and powers which they had not, having the same end in view.

Persistence of Types.

These types still persist, but with the progress of civilization and the spread of education their standing has changed greatly. The old alchemist practised his art in secret and silenced his dupes by threats of imaginary powers, or by the hope of gain. The so-called philosophers of those days were in a not much better position, for if they made a real discovery or formulated a law hitherto not recognized, they stood in danger of being judged as wicked heretics, or, at least, as men dangerous to be at liberty. Not infrequently, the great philosophers announced their discoveries in cipher as they dared not make an open statement.

Conditions To-day.

How different are conditions to-day; a discovery, or what is supposed to be a discovery, is heralded from one end of the earth to the other. There is not only no danger to the discoverer from this publicity, but it is practically impossible for a modest student to avoid this, to him, undesirable notoriety. On the other hand, this free advertising is just what those persons who have a great scheme for others to invest in wish. Scarcely a day passes without an announcement of some discovery or invention which will accomplish wonders. In rare cases the announcement is strictly true; sometimes, however, it is merely a new story of an old matter. But in the vast majority of instances we learn simply of another scheme to fleece the credulous.

Some Recent Announcements.

It may be interesting to mention a few instances which have come to our notice recently. We have been told about a wonderful primary battery which will solve the automobile problem. It is said that by means of this invention we will be enabled to make longer trips at the expense of but a few cents for fresh electrolyte, and we are shown a picture of the apparatus to prove the truth of this statement. It is unfortunate in this case that the cost of the zinc was overlooked, but that is a small matter. New primary batteries are invented so frequently that it is a hopeless task to keep track of them.

Air as a Source of Power.

We are told of a method by which unlimited power may be abstracted from the air, which will make the steam boiler a thing of the past and convert our coal mines into useless holes in the ground.

Bible Study a Way to Discoveries.

Again, we hear of a force, discovered after a long and earnest Bible study, a force which has escaped the so-called scientific men of all ages, but which now will work a revolution in all branches of industry.

Electricity Used to Catch the Unwary.

It would seem that the word "electricity" is used as a bait to catch the unwary more than is fair. There is a magic in the sound that charms, when all else fails. It is used to cloak the plainest frauds and no amount of protest of the scientific avails. Its powers and properties are described in as many ways as there are schemes to promote. To quote from a recent circular: "Electricity is a foreigner; it comes to mankind with a brogue, and little else is known about it by humanity. Electricity's presence in the earth's mass is by seepage from the surrounding ether. Electricity . . . then hurries away to its lair, the depths of the mysterious and mighty ether. From the earth's mass outward, in every direction, the mind of man contemplates persistent and insatiable distance engulfing persistent and insatiable distances; then, behold, along rolls the mighty ether; this unfathomable mystery swallows up, in utter contempt of their magnitude, all these distances and passes on." (The hiatus is in the circular.) He must be a credulous man indeed, who, after reading this, still has doubts about the practicability of throwing a cable some two hundred miles long into air, and in this way obtaining control of unlimited power!

Traction Schemes.

Railway problems are of great importance at this time, so one should not be surprised when he hears of marvelous inventions by which terrific speeds may be obtained with absolute security and with but a slight expense for power. We read recently of a train, the weight of which is to be supported by magnets which slip along under a rail. A picture of the train gave a clear idea of its construction. The magnets used were almost negligibly small, but it hardly seems good practice to reduce the tractive power of the locomotive by lifting it off the rails. These same magnets would doubtless make very effective magnetic brakes, and soon bring the train to a standstill after shutting off the power so that the expense of an air-brake equipment would be avoided. This train consumes only "two per cent of current, leaving ninety-eight per cent to be used for other purposes." It would seem good practice to double the current so that but one per cent would be required by the locomotive.

Flying Machines.

Closely allied in a certain sense to the traction problem, is the problem of the flying machine, so that it is natural to expect descriptions more or less clear of new methods of propulsion. Often the writer excuses his lack of definiteness by stating that it is necessary to guard his patents.

True Inventions Unfortunately Announced.

At times a legitimate announcement is made, but in such terms as to deceive many. We see a description of a wonderful discovery which will take the place of an old superstition, the witch hazel rod, for instance. At first thought, one would feel inclined to read no further

than the head lines, but should he follow this rule, invariably he might miss an interesting story, as a case of this kind came to our own notice recently.

A Question for Thought.

The question which presents itself now is, does any harm arise from these sensational stories? Who is to decide whether there is any truth in a new story. At times the most visionary dreamer may be correct, and the practical man at fault. Who is to say that an invention is no invention, or is valueless, and who of us does not enjoy a well written description of the plainest swindle. But we can not all of us have scientific educations, and the unknowing still continue to invest their hard earned savings in schemes as unpracticable as some of those we have mentioned above, and probably to a greater degree than is generally believed. Many of the schemers prosper and some one pays the freight. Whose business is it, if it is any one's, to rush to the rescue of the unfortunate?

AMERICAN ELECTROCHEMICAL SOCIETY.

The American Electrochemical Society will hold its third general meeting in New York city, April 16 to 18. The local committee has been actively at work for the last two months making preparations, and the outlook at the present time is for a very successful convention. Valuable papers are promised by prominent electrochemical experts, and interesting visits have been arranged for to important plants and establishments in the vicinity of New York.

Creditable Membership Roll.

Although the American Electrochemical Society is but one year old, it has already held two most successful meetings. It now has enrolled about 500 members, drawing its support from those in practical work, as well as those engaged in the theoretical advancement of electrochemistry.

Advantages of New York as Place of Meeting.

The selection of New York for the third place of meeting was made because, except Niagara Falls, where the second meeting was held, there is probably no other place in the world where so much electrochemical work is being carried on. There is every reason to expect that the hopes of the local committee for the most successful meeting of the society yet held will be realized.

THE GROWTH OF THE TELEPHONE INDUSTRY.

When, at any time, we attempt to estimate the growth of a thriving industry, we find it necessary and a good practice to compare the aggregate of to-day with the total of some fixed prior period. Where only one set of figures is at hand, these must be referred to in relative fashion; and where it is known in what ratio the individual increments that go to make the composite statistics have been developed, it becomes a matter of analysis and deduction to accord to each factor its value in the progression.

The Automatic System.

And so it is with the telephone situation of to-day. Beginning with the most recent development—the automatic system—there have been great strides made in this direction. Apparently this form of service is giving satisfaction to those who have suffered its inauguration. To date the system has been under trial in comparatively small exchanges; but contracts have already been secured and installations are under way where the most rigid large capacity exactions will have to be met.

The Manually Operated Exchange.

Looking over the field served by the manually operated exchanges, the great wealth represented by this industry becomes at once apparent. While the independent interests are more or less welded together by the bond of national organization, the operation of securing exact data is not easy, and until thorough clearing-house methods are adopted, and accurate reports made to one central head, it will be hard to show this with any great degree of precision.

Magnitude and Growth.

Probably the most intelligent conception of the magnitude of the telephone business and of its great growth will be secured from reference to the recent report of the American Telephone and Telegraph Company, the parent company of the great Bell system. The gross revenue for the year 1902 amounted to $13,277,457.33. The expenses, including interest and taxes, were $5,442,185.14. The total amount added to construction and real estate by all the companies constituting this system was $37,336,500. The total miles of wire on January 1, 1903, were 2,443,750, an increase for the year of 714,731 miles. Of this increase, 1,848 miles are represented by submarine circuits, which now total up to 6,048 miles. One of the most interesting figures in this table shows the extent to which underground construction has been carried out during the past year. On January 1, 1903, there were 1,328,685 miles of wire underground, or 219,668 miles in excess of that overhead, showing an increase in underground wire of 445,006 miles, as against 267,877 miles increase for overhead lines. The estimated number of exchange connections made daily was 9,322,951, or a total for the year of about 3,002,000,000.

Increased Capitalization.

To keep up with this demand for service the stockholders of this company have authorized an increase in capital stock from $150,000,000 to $250,000,000. This increase is to be used in the development of new lines and the rehabilitation of old properties.

Present Outlook.

The independent telephone interests claim that this expansion has nearly been equaled. Under more practical management the rates being charged by independent telephone companies are based more on the economic values of properties as a whole, and competition is rapidly assuming a more healthy condition. The independent interests are certainly now reaping the benefit of skilled employés, practical managers and highly trained electrical engineers. Notwithstanding the efforts which are being made by each factor in the contest to secure virgin territory and to acquire properties which have already been inaugurated, there is to-day a trebled demand for service, and the prospect, as voiced by all of the operating companies, is that the coming year will witness a still greater expansion than the year just closed.

Transformers in Transmission Systems.

By Alton D. Adams.

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TRANSFORMERS are almost always necessary in long electric systems of transmission, because the line voltage is greater than that of generators or at least that of distribution. As transformers at either generating or receiving stations represent an increase of investment without corresponding increase of working capacity, and also an additional loss in operation, it is desirable to avoid their use as far as is practicable. In short transmissions over distances of less than fifteen miles it is generally better to avoid the use of transformers at generating stations, and in some of these cases, where the transmission is only two or three miles, it is even more economical to omit transformers at the substations.

Thus, where energy is to be transmitted two miles and then applied to large motors in a factory, or distributed at 2,500 volts, the cost of bare copper conductors for the three-phase transmission line will be only about $6 per kilowatt of line capacity at 2,500 volts, with copper at fifteen cents per pound, and a loss of five per cent at full load. The average loss in such a line will be smaller than that in one set of transformers and a line of higher voltage. Furthermore, the first cost of the 2,500-volt generators and line without transformers will be less than that of generators and line of higher voltage with step-down transformers at the substation.

As generators up to 13,500 volts are now regularly manufactured, it is quite common to omit step-up transformers at the main stations of rather short transmission systems. This practice was followed in the 13,500-volt transmission to Manchester, N. H., the 10,000-volt transmission to Lewiston, Me., and the 12,000-volt transmission to Salem, N. C.

In most transmissions over distances of twenty-five miles or more step-up transformers at generating stations as well as step-down transformers at substations are employed. As yet the highest voltages that have been put into practical use on transmission lines, that is 50,000 to 60,000, are much below the pressures that have been yielded by transformers in experimental work. These latter voltages have in a number of instances gone above 100,000. The numbers and capacities of transformers used at main stations vary much in their relations to the numbers and individual capacities of generators there. In some cases there are three times as many transformers as three-phase generators, and the capacity of each transformer is either equal to or somewhat greater than one-third of the capacity of each generator.

Thus in the station at Spier Falls on the Hudson, whence power will be transmitted to Albany and other cities, the number of step-up transformers will be thirty and their aggregate capacity will be 24,014 kilowatts, while the total number of three-phase generators will be ten, with a combined capacity of 24,000 kilowatts. Another practice is to give each transformer a capacity greater than one-third of that of the three-phase generator with which it is to be connected, and make the total number of transformers less than three times as great as the number of generators. An example of this sort exists in the station on Apple River, whence power is transmitted to St. Paul. This station contains four three-phase generators of 750 kilowatts each, and six transformers of 500 kilowatts each, these latter being connected in two sets of three each. The use of three transformers for each three-phase generator instead of three transformers for each two or three generators, tends to keep transformers fully loaded when in use, and therefore to increase their efficiency. On the other hand, efficiency increases a little with the size of transformers and the first cost per unit capacity is apt to be less the greater the size of each.

Another solution of the problem is to provide one transformer for each three-phase generator, each transformer being wound with three sets of coils, so that the entire output of a generator can be sent into it. This practice is followed in the Hochfelden water-power station, whence power is transmitted to Oerlikon, Switzerland, also in the water-power station at Grenoble, France, whence energy at 26,000 volts is transmitted to a number of factories. With three-phase transformers each generator and its transformer may form an independent unit that can be connected with the line at pleasure, thus tending to keep transformers at full load.

Though three-phase transformers are much used in Europe, they have thus far had little if any application in the United States. Single-phase transformers may, of course, be limited in number to that of the three-phase generators with which they are used, but such transformers must regularly be connected to the generators and line in groups of three. Such an equipment was provided in part at the 7,500-kilowatt station on the Missouri River at Cañon Ferry, which contains ten three-phase generators of 750 kilowatts each. The transformers at this station include twelve of 325 kilowatts each, connected in four groups of three each, also six transformers of 950 kilowatts each which are also connected in groups of three. Three of these larger transformers have a capacity of 2,850 kilowatts, or nearly equal to that of four generators.

With two-phase generators single-phase transformers must be connected in pairs, and it is common to provide two transformers for each generator. Thus, in the Rainbow station on the Farmington River, whence power is transmitted to Hartford, there are two generators of the two-phase type and rated at 600 kilowatts each, also four transformers rated at 300 kilowatts each.

As the regulation of transformers on overloads is not as good as that of generators, it seems good practice to give each group of transformers a somewhat greater capacity than that of the generator or generators whose energy is to pass through it. This plan was apparently followed at the Cañon Ferry station, where the total generator capacity is 7,500 kilowatts and the total capacity of step-up transformers is 9,600 kilowatts. Each group of the 325-kilowatt transformers there has a capacity of 975 kilowatts, while each generator is only of 750 kilowatts. Usually the number of groups of transformers at a two-phase or three-phase generating station is made greater than the number of transmission circuits supplied by the station, for some of the reasons just considered. Where this is not the case it is commonly desirable in any event to have as many groups of step-up transformers as there are transmission circuits, so that each circuit may be operated with transformers that are independent of the other circuits.

At substations it is desirable to have a group of transformers for each transmission circuit, and it may be necessary to subdivide the transformer capacity still further in order to keep transformers in operation at nearly full load, or to provide a group of transformers for

each sort of service or for each distribution circuit. All of the transformers at a substation should have a total capacity at least equal to that of the generators whose energy they are to receive, minus the losses in step-up transformers and the line. Transformers at substations do not necessarily correspond in number or individual capacity with those at generating stations, and the number of substation transformers bears no necessary relation to the number of generators by which they are fed.

Two transmission circuits extend from Cañon Ferry to a substation at Butte, and in that substation there are six transformers devided into two groups for three-phase operation, each transformer being rated at 950 kilowatts. This substation equipment thus corresponds to only the six 950-kilowatt transformers in the generating station, because the four groups of smaller transformers there are used to supply the transmission line to Helena.

In the substation at St. Paul that receives the entire output of the plant on Apple River, where the six transformers of 500 kilowatts each are located, ten transformers receive energy from two three-phase transmission circuits. Six of these transformers are rated at 300 kilowatts each, and four at 200 kilowatts each. The 300-kilowatt transformers are connected in two groups of three each, and the 200-kilowatt in two groups of two each, transforming current from three-phase to two-phase. The aggregate capacity of the substation transformers is thus 2,600 kilowatts, while that of transformers at the generating station is 3,000 kilowatts. With four generators at the water-power plant there are ten transformers at the substation, where all the energy, minus losses, is delivered.

At Watervliet, where one of the several substations of the system with its larger generating plant at Spier Falls is located, the capacity of each transformer is 1,000 kilowatts, though each transformer at Spier Falls has a rating below this figure.

In the substation at Manchester, N. H., that receives nearly all of the energy from four water-power plants, containing eight generators with an aggregate capacity of 4,030 kilowatts, there are located twenty-one step-down transformers that have a total rating of 4,200 kilowatts. These twenty-one transformers are fed by six circuits, of which five are three-phase and one is two-phase. A part of the transformers supply current to motor-generators, developing 500-volt current for a street railway, and the remaining transformers feed circuits that distribute alternating current.

From these examples it may be seen that in practice either one or more groups of transformers are employed in substations for each transmission circuit, that the total number of these transformers may be just equal to or several times that of the generators from which they receive energy, and that the individual capacities of the transformers range from less than one-third to more than that of a single generator. Groups of transformers at a main station must correspond in voltage with that of the generators in the primary and that of the transmission line in the secondary windings. Substation transformers receive current at the line voltage and deliver it at any of the pressures desired for local distribution. Where step-up transformers are employed the generator pressure in nearly all cases is at some point between 500 and 2,500 volts.

At the Cañon Ferry station the voltage of transformer groups is 550 in the primary and 50,000 in the secondary windings. In the Colgate power-house, whence energy is transmitted to Oakland and San Francisco, the generator pressure of 2,400 volts is raised to 40,000 volts by transformers. Generator voltage in the power-house on Apple River is 800 and transformers put the pressure up to 25,000 for the line to St. Paul. Transformers at the Niagara Falls station raise the voltage from 2,300 to 22,000 for the transmission to Buffalo.

As transformers can be wound for any desired ratio of voltages in their primary and secondary coils, a generator pressure that will allow the most economical construction can be selected where step-up transformers are employed. In general it may be said that the greater the capacity of each generator, the higher should be its voltage and that of the primary coils of step-up transformers, for economical construction. At substations the requirements of distribution must obviously fix the secondary voltages of transformers.

Weight and cost of transformers depend in part on the frequency of the alternating current employed, transformers being lighter and cheaper the higher the number of cycles completed per second by their current, other factors remaining constant. In spite of this fact the tendency during some years has been toward lower frequencies, because the lower frequencies present marked advantages as to inductive effects in transmission systems, the distribution of power through induction motors, the construction and operation of rotary converters, and the construction of generators. Instead of the 133 cycles per second that were common in alternating systems when long transmissions first became important, sixty cycles per second is now the most general rate of current changes in such transmission systems. But practice is constantly extending to still lower frequencies. The first Niagara Falls plant with its twenty-five cycles per second reached the lower limit for general distribution, because incandescent lighting is barely satisfactory and arc lighting decidedly undesirable at this figure.

In contrast with the great transmissions from Cañon Ferry to Butte, Colgate to Oakland, and Electra to San Francisco, which operate at sixty cycles, the system between Cañon City and Cripple Creek, in Colorado, as well as the great plant at Sault Ste. Marie, employs thirty-cycle current, and the lines from Spier Falls to Schenectady, Albany and Troy are intended for current of forty cycles per second. From these examples it may be seen that the bulk and cost of transformers is not the controlling factor in the selection of current frequency in a transmission system.

Transformers used at either generating or substations should be cooled by some special means unless quite small, say under 100 kilowatts capacity each.

The advantages of so-called artificial cooling are smaller weight and first cost in transformers, and perhaps slightly longer life for the insulation of windings. For these advantages a small increase in the cost of operation must be paid. Station transformers are usually cooled either by forcing air through them under pressure, or else by passing water through pipes immersed in the oil with which the transformers are insulated. If cooling with air-blast is adopted, a blower, with electric motor or some other source of power to operate it, must be provided. Where transformers are oil-insulated and cooled with water there must be some pressure to maintain the circulation. If free water under a suitable head can be had for the cooling of transformers, as in most water-power plants, the cost is very slight. Where water must be purchased and pumped through the transformers its cost will usually be greater than that of cooling with air-blast. One manufacturer gives the following as approximate figures for the rate at which water at the temperature of fifteen degrees centigrade must be forced

through his transformers to prevent a rise of more than thirty-five degrees centigrade in their temperature, probably when operating under full loads.

Transformer—Kilowatts.	Gallons per minute.
150	0.5
400	0.75
600	1.00
1,000	1.5
75	0.37

An air-blast to cool transformers at main or substations may be provided in either of two ways. One plan is to construct an air-tight compartment, locate the transformers over openings in its top, and maintain a pressure in the compartment by means of blower fans that draw cool air from outside. Such an arrangement has been carried out at the substation in Manchester, N. H. The basement underneath this substation is air-tight and in the concrete floor over it there are twenty-seven rectangular openings, each twenty-five by thirty inches, and intended for the location of a 200-kilowatt transformer. Aggregate transformer capacity over these openings will thus be 5,400 kilowatts. Pressure in this basement is maintained by drawing outside air through a metal duct that terminates in a hood on the outside of the substation about nine feet above the ground. In the roof of this substation there are ample skylight openings to permit the exit of hot air that has been forced through the transformers. In the air-tight basement are two electric motors of ten horse-power each, connected to the blower that maintains the pressure. It may be noted that in this case there is less than one horse-power of motor capacity for each 200 kilowatts capacity in transformers.

Where there are not more than six or nine transformers to be cooled, it is common practice to provide a separate motor and blower for each group of three transformers, and lead the air directly from each blower to its group of transformers by a metal duct, thus avoiding the necessity for an air chamber. In such cases a blower giving a three-eighth-ounce air pressure per square inch and a motor of one-horse-power capacity are generally provided for each group of three transformers rated at 100 to 150 kilowatts each. Where cooling with air-blast is adopted, oil insulation can not be carried out because the air must come into intimate contact with the transformer coils and core. Both oil insulation with water cooling, and dry insulation with cooling by air-blast have been widely used in transmission systems of large capacity and high voltage.

In the Colgate plant, where the line pressure is 40,000 volts, the 700-kilowatt transformers are oil-insulated and water-cooled, and this is also true of the 950-kilowatt transformers in the 50,000-volt transmission between Cañon Ferry and Butte. On the other hand, the transmission system between Spier Falls, Schenectady and Albany, carried out at 26,500 volts, includes transformers that range from several hundred to 1,000 kilowatts each in capacity and are all air-cooled. Either a water-cooled transformer or one cooled by air-blast may be safely overloaded to some extent, if the circulation of air or water is so increased that the overload does not cause heating beyond the allowable temperature.

(To be concluded.)

The American Electrochemical Society.

The American Electrochemical Society will hold its third general meeting in New York city, April 16 to 18, at the Chemists' Club, 108 West Fifty-fifth street. A number of valuable papers will be presented and discussed, and excursions will be made to various points of interest. A good attendance of outside members is expected.

A paper by Mr. Nelson W. Rogers upon the Cooper Hewitt vapor converter will be presented, and the apparatus will be shown in action.

At the banquet which will be held at the German Liederkranz clubhouse, 111 East Fifty-eighth street, on April 16, at 8 P. M., the following distinguished gentlemen will be the guests of the society: Dr. Walther Nernst, Göttingen, Germany, inventor of the Nernst lamp, and one of the leading electrochemists of the world; T. J. Baker, president of the American Chemical Society; Charles F. Scott, president of the American Institute of Electrical Engineers; William McMurtrie, president of the Chemists' Club, New York city; James M. Dodge, president of the American Society of Mechanical Engineers; V. Coblentz, president of the New York section of the Society of Chemical Industry; A. R. Ledoux, president of the American Institute of Mining Engineers; S. A. Ringler, president of the German Liederkranz; Dr. H. W. Riley, chief chemist of the Agricultural Department, Washington, D. C., and Dr. Samuel Sheldon, president of the New York Electrical Society. An excellent musical programme has been arranged by Mr. Carl Schlegel, of the German Liederkranz, assisted by Mrs. Annie Eisen, and the banquet will be attended by a number of ladies.

The American Electrochemical Society was founded in April of last year and the first general meeting was held in Philadelphia at that time. The second general meeting was held at Niagara Falls during October, 1902. The society has now about five hundred members. It was organized to promote the interests of theoretical and applied electrochemistry and electrometallurgy, and its influence has already been felt in that new and rapidly growing industry. Its membership includes most of the prominent electrical engineers and electrochemists in this country. The selection of New York as the place for the third general meeting was made because, excepting Niagara, where the second meeting was held, there is probably no other place in the world where so much electrochemical work is being carried on.

The following excursions have been arranged:

Friday, April 17—First party leaves at 2 P. M., arrive Willyoung & Gibson Company, 40 West Thirteenth street, about 2.30. Leave three o'clock for Crocker-Wheeler Electric Works, at Ampere, N. J. Leave Christopher Street Ferry 3.30 sharp, arrive at 4.20. Return by 5.25 train to New York, arriving at six o'clock.

Second party leaves at 2 P. M., arrive Sawyer-Man Electric Company, 510 West Twenty-third street, at 2.30; leave at 3.30, arrive Eimer & Amend (special exhibit), Third avenue and Eighteenth street, at 3.45; leave at 4.15, arrive at Cooper Union, Third avenue and Eighth street, at 4.30.

Third party leaves at 2 P. M., arrive United States Electro-Galvanizing Company, 9 Park avenue, Brooklyn, at three o'clock; leave 3.30, arrive Brooklyn Navy Yard at four o'clock.

Saturday, April 18—First party leaves at 2 P. M., arrive New York Edison Station, Thirty-eighth street and East River at 2.30; leave three o'clock, arrive Manhattan Railway Company's power-house, Seventy-fourth street and East River, at 3.30; leave at four o'clock, arrive at power-house Metropolitan Street Railway Company, Ninety-sixth street and First avenue, at 4.15; leave at 4.45 for Columbia University, West 116th street.

Second party leaves at 2 P. M. to inspect Rapid Transit Tunnel at Fifty-ninth street and Broadway; leave at three o'clock for Columbia University, West 116th street.

A NEW STEAM TURBINE.

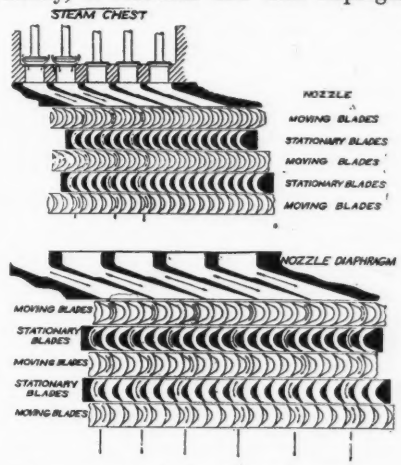
A DESCRIPTION OF THE CURTIS STEAM TURBINE.

Steam turbines have of late occupied a prominent place in plans for future power installations. For this reason, an abstract of a paper prepared by Mr. W. L. R. Emmet, which describes the steam turbine invented by Mr. C. G. Curtis, of New York, will prove of interest. The ideas made use of in this turbine were first obtained about 1895. Since that time, experimental work has been carried on at Schenectady under the direction of Mr. Curtis and of the General Electric Company's engineers, the object of these experiments being to establish data and laws which would form a basis for the correct design of commercial apparatus. About two years ago, results of these experiments gave data which showed great commercial possibilities, and since that time, work has gone on on a large scale in the production of commercial machines. The contracts of these machines now aggregate 230,000 horse-power in turbine-driven electric generating units, the largest size so far built being 7,500 horse-power.

The idea of the steam turbine is quite simple, and is similar to that of the water turbine or impulse wheel. The practical difficulty which has prevented the development of good steam turbines lies in the very high velocity which steam can impart to itself in expansion, and the difficulty in efficiently transferring this motion to wheels at speeds practicable for construction or practical use. Steam expanding from 150 pounds gauge pressure per square inch into the atmosphere is capable of imparting to itself a speed of 2,950 feet per second, and if it is expanded from 150 pounds gauge pressure into a twenty-eight-inch vacuum, it can attain a velocity of 4,010 feet per second. The spouting velocity of water discharged from a nozzle from 100-foot head is eighty feet per second, which shows the radical difference in the conditions to be met in steam and hydraulic turbines.

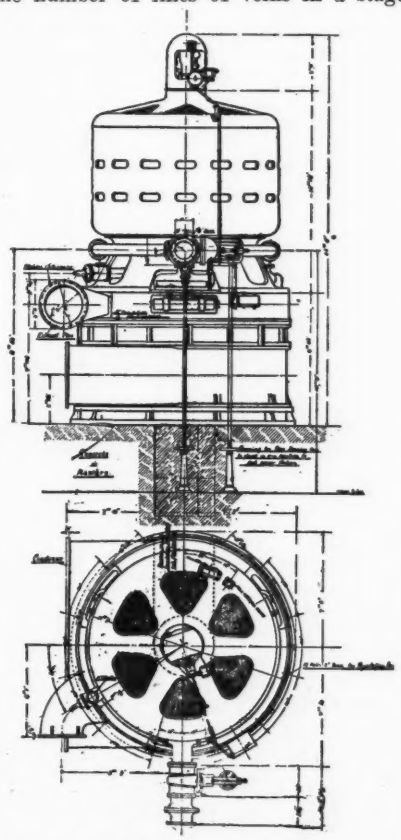
Previous to the development of the Curtis turbine, there were two practical methods of using steam in turbines with fair economy. In one of these, the steam is allowed to expand within a nozzle and then impinges upon suitably arranged buckets. To secure high efficiency in this method, a high peripheral speed of turbine is necessary. In the second method, steam is allowed to expand in its passage through a system of alternately fixed and movable veins. The method developed in the Curtis turbine consists in expanding the steam nearly completely in suitable nozzles and then allowing it to pass through a system of veins alternately fixed and movable and so arranged that the steam has a very high speed where it enters, but which it loses almost entirely before it leaves the turbine.

The accompanying illustration shows the general arrangement of this turbine. The steam leaves the steam chest through one or more parts and enters the nozzles, where it is almost completely expanded. It then impinges upon the first set of moving blades. Striking these with a high velocity, it rebounds and then impinges



DIAGRAMS OF NOZZLES AND BUCKETS.

upon the first set of stationary blades. Here it again rebounds and passes to the second set of moving blades, and so on through as many sets or stages as may be necessary. The number of stages and the number of lines of veins in a stage



PLAN OF 5,000 KILOWATTS, 500 REVOLUTIONS PER MINUTE, WITH GENERATOR.

are governed by the degree of expansion, the peripheral velocity, which is desirable or practicable, and by various conditions in the mechanical expediency. Generally speaking, lower peripheral speeds entail more stages, more lines of veins per stage, or both. The general practice in the construction of these turbines is so to divide up the steam expansion that all stages handle about equal parts of the total power of the steam.

The losses and leakages of the earlier stages take the form of more heat or more steam for the lower stages and are thus in part regained. Much water of expansion which might occasion losses by evaporation is drained out of each stage into that which succeeds it.

Governing is effected by the successive opening or closing of nozzles and consequent changing of the active steam belt. The cut shows part of the nozzles open and part closed, the arrows showing the space filled up by live steam. In the process of governing, the nozzles of the later stages may or may not be opened and closed, so as to maintain an adjustment in proportion to that of the first stage.

From tests of an early type of this turbine which were conducted at Schenectady, it was found that with steam at 140 pounds pressure and a vacuum of 28.5 inches, a 600-kilowatt machine consumed 19.5 pounds of water per kilowatt-hour, at an output of 475 kilowatts, without superheat. At 600-kilowatt output, the steam consumption fell to 19.2 pounds, and at 775 kilowatts it was 19.1, thus showing a good range of efficient operation. With steam superheated to 150 degrees Fahrenheit, the marked economy of this method of operation for steam turbines was realized. At an output of 450 kilowatts, the consumption of steam was 17 pounds per kilowatt-hour for the same turbine. At 600 kilowatts output, the consumption was 16.75, and at 775 kilowatts it was 16.7 pounds of steam per kilowatt-hour. One of these turbines, having a capacity of 5,000 kilowatts, will soon be put into operation in Chicago. This machine is expected to give considerably better steam economy than those just noted, particularly in the matter of light load performance. It is estimated that the variation of efficiency in this machine from half load to fifty per cent overload need not exceed three per cent. The performance of this machine will be watched critically, and further information regarding the construction of these turbines will be awaited with interest.

The National Electric Light Association.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

The Central Passenger Association has granted a special rate of a fare and one-third, on the certificate plan, from all points in its territory to Chicago and return, for delegates attending the twenty-sixth convention of the National Electric Light Association, to be held in Chicago, May 26, 27 and 28, 1903.

C. O. BAKER, JR.,
Master of Transportation.

New York, April 6.

Some Typical Western Industries.

An Illustrated Description of Three Installations—The Telluride Reduction Company, the Portland Chlorination Mills, and the United States Reduction and Refining Company.

By J. H. Rusby.

TELLURIDE REDUCTION COMPANY.

THE plant of the Telluride Reduction Company is situated on Bear Creek, some two miles southwest of Colorado Springs, Col. This establishment is devoted to the reduction of various Cripple Creek ores, which are shipped in over the Colorado Midland Railroad and the Cripple Creek Short Line.

The substation and motor installation of this plant is under the management of Mr. N. B. Ayrs. Both the milling plant and electrical equipment are undergoing a fifty per cent extension of capacity at the present time.

In equipping this plant, the Telluride Reduction Company found it expedient to purchase its electric power from the Colorado Springs Light and Power Company, rather than to install engines, boilers and generators for this supply. Three-phase alternating current of sixty cycles, 7,200 alternations, at 6,200 volts, is received at the substation, which is a red brick structure fourteen by thirty feet, with an iron and slate roof and cement floor. The high-tension circuits enter through the usual choke coils and lightning arresters, and the current is transformed to 460 volts, at which pressure it is distributed throughout the mill to the various motors. Five 175-kilowatt transformers are arranged in a line down the centre of the station. At one end of the room, and parallel with the longer dimension, is the primary board. This is built of Vermont gray marble, and upon it is mounted a main-line, oil-break, three-pole switch, to cut out the entire system; a similar switch to cut out the primary of the lighting transformers, and the watt-meters and necessary current and potential transformers.

Along the primary side of the five transformers is a five-panel board of gray marble, with a three-pole, oil-break switch and a three-pole plug switch for each transformer. On the secondary side is a similar board with plug switches for each transformer.

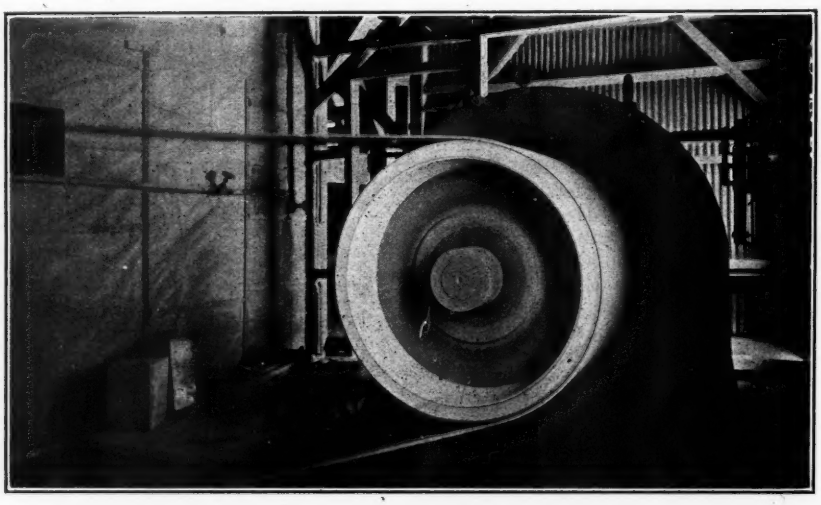
Usually four transformers are in operation, which leaves one in reserve in case of accident. By opening its primary oil switch the secondary circuit can then be broken without difficulty by the plugs, and a new transformer can be plugged in.

It was learned by experiment, and contrary to expectations, that with the primary open, the secondary circuit could be cut loose from the bus-bars in this way without arcing.

Light is supplied by two transformers of ten kilowatts capacity each. These are connected through the oil switches mentioned above to the 6,200-volt main line, and on the secondary side for three-wire Edison distribution through a single panel-board.

The plant includes the following motors: One each of ten, fifteen, fifty, 150 and 200 horse-power; two of seventy-five horse-power, five of twenty horse-power, and thirty of thirty horse-power.

The internal resistance of the motors used causes some trouble, on account of the difficulty of keeping them free from dust in this kind of a mill; and the dust, by collecting on the resistance grids and under the brushes, causes the former to short-circuit and the latter to arc and burn out. Also, where a heavy starting current is required, as on the 100-horse-power motor, where heavy machinery is belted direct to the main shaft by a heavy wheel, the effect on the brushes is more or less destructive. Outside of these difficulties the use of motors in this establishment has been found very satisfactory.



200-HORSE-POWER MOTOR—TELLURIDE REDUCTION COMPANY.

PORTLAND CHLORINATION MILL.

The Portland Chlorination Mill is situated on Bear Creek, one mile west of Colorado Springs, and is devoted to the treatment of this company's Cripple Creek ores. As above, the ores are shipped in over the Colorado Midland Railroad and the Cripple Creek Short Line.

The substation and motor installation are in charge of Mr. O. E. Freeman. The power for this installation is purchased from the Colorado Springs Light and Power Company, current being received at the substation at 6,200 volts, 7,200 alternations, three-phase, sixty cycles. At the substation the current is stepped down to 460 volts, by means of four 250-kilowatt oil transformers. The primary and secondary switchboards are built up of Vermont gray marble, with flush connections. On the panels of these switchboards are mounted the following instruments: On the primary board—all necessary plug switches, so arranged that any desired combination of transformers may be obtained; a double-pole oil switch for the primary of each transformer, the primaries and secondaries of the transformers being connected in delta. On the secondary board—two Westinghouse voltmeters, one for power and one for light; one polyphase indicating watt-meter, and two Thompson recording watt-meters.

From the secondary switchboard the current is transmitted by overhead lines to the various lights and motors throughout the milling plant. All of the machinery in this installation is electrically driven and the plant is lighted throughout by arc and incandescent lamps.

The following is a list of the motors

in use: Twenty induction motors, ranging from 20 to 200 horse-power; two variable speed induction motors, with a normal rating of thirty horse-power; two revolving-field synchronous motors of 200 and 300 horse-power, respectively.

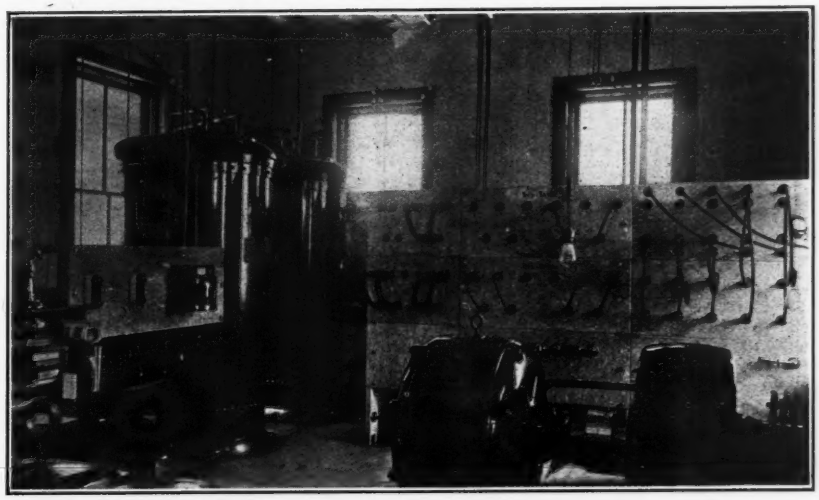
TRANSFORMERS AND EXCITERS, PORTLAND CHLORINATION MILL.

By over-exciting the fields of these synchronous motors, a power-factor of from eighty-five to ninety per cent has been obtained. The exciter sets for these two motors are situated in the transformer house. The synchronous induction motors are belt-connected to driving shafts which transmit the power to desired operating points. The smaller induction motors have proved very satisfactory in this plant since the initial installation.

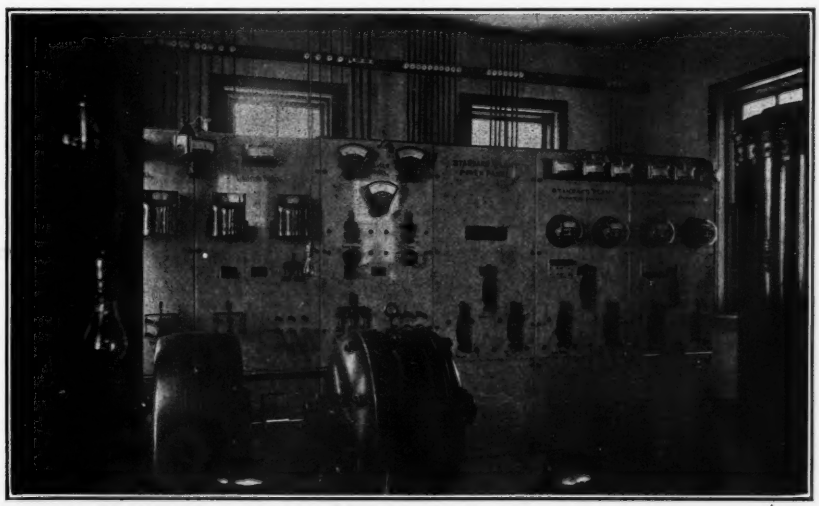
THE STANDARD PLANT OF THE UNITED STATES REDUCTION AND REFINING COMPANY.

The standard plant of the United States Reduction and Refining Company is located at Colorado City, Col., and the electrical equipment is in charge of Mr. M. O. Watson. Current is received from the Austin's Bluffs power-house of the Colorado Springs Light and Power Company, about four miles away. It is transmitted at 6,600 volts over four sets of lines. This precaution is necessary to secure continuous service, as the lightning is a factor which has to be seriously reckoned with in this part of the country. The current used is three-phase, sixty-cycle 7,200 alternations. At the company's plant this is stepped down to 440 volts for power, the lighting current coming in on separate lines at 2,200 volts, and being stepped down to 104 volts.

The primary switchboard is built up of two gray marble panels, and is equipped with plugging cables and quick-break oil switches, so that current from any set of lines can be thrown on to the primary bus-bars. The two left-hand sections of the board are provided with switches and plugs for throwing in or out any of the four transformers. These transformers are each of 250-kilowatt capacity, and are water-cooled.



PRIMARY SWITCHBOARD AND TRANSFORMERS, UNITED STATES REDUCTION AND REFINING COMPANY.



SECONDARY SWITCHBOARD, TRANSFORMERS AND ROTARY, UNITED STATES REDUCTION AND REFINING COMPANY.

The lighting panel is fed from four transformers, aggregating seventy-kilowatt capacity, and is arranged for the three-wire system, which is used throughout the mill.

The current-generating apparatus furnishes direct current for the exciters at 125 volts, for the synchronous motors, and also for lighting purposes, should the lighting current fail at any time. The generating apparatus consists of two twenty-kilowatt, 125-volt generators, direct-connected to two thirty-horse-power, three-phase, sixty-cycle, 440-volt, induction motors.

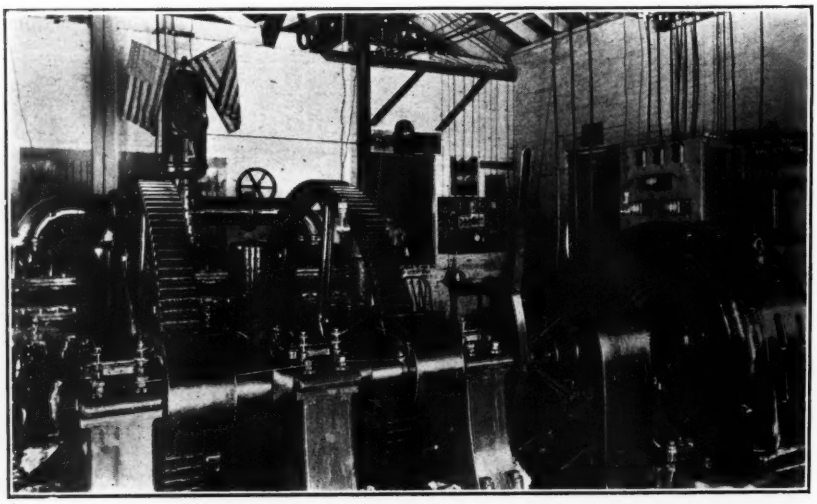
One of the illustrations shows the front of the secondary panels for both power and light. The two left-hand sections of the board form the lighting panel, and are equipped with ammeters and voltmeters for the three-wire system, and separate wattmeters for the incandescent lights and for each of the three groups of buildings, together with one for the arc lights placed around the buildings. In all, about 1,500 incandescent and thirty arc lights are used.

The panel next to this is the exciter panel, and is provided with ammeters and voltmeters connected to the two exciter sets. On these two also are switches whereby the machines can be thrown on to their bus-bars in multiple, or on to the lighting busses in series. Switches are also provided on the rear board for cutting out the transformer secondary feeders.

The two panels on the right show the meters and switches of the power circuits of the two mills.

In the attic overhead, where the transmission circuits enter and leave the building, lightning arresters and choke coils are provided. These are especially numerous on the primary power circuit, which appears to have a particular attraction for the static effects of lightning storms.

The motor equipment consists of thirty-seven motors, ranging from 5 to 235 horse-power, and aggregating some 1,600 horse-power. These are all three-phase, sixty-cycle, 440-volt, induction motors, except two, which are synchronous motors—one of 235 horse-power, and the other of 120 horse-power. Every motor in the mill is provided with a marble starting panel mounted with expulsion fuse blocks and a quick-break oil switch. The two synchronous motors are provided with starting switches and compensators. The 120-horse-power synchronous motor is direct-connected to a large triplex-cylinder pump in the pumping station. A large amount of water is needed in the reduction process. This set runs continuously like the rest, pumping over 1,000 gallons of water per minute to two large tanks at the top of the hill, against a head of 235 feet. A float in the tank registers the number of feet of water on a current ammeter located in the pumping station, the scale of the instrument registering the number of feet of water in the tank. Probably the only unusual feature about the electrical equipment of this plant is that it runs continuously, day and night, with few breaks. The motors are given constant attention, the electricians making a round and careful inspection every eight hours. The greatest care is exercised to guard against any accident which might cause even a temporary shutdown to any part of the plant. Extra motors and extra parts are kept in stock in the storeroom, and men are held in readiness to effect a very quick change of motors in case of accident, as continuous service is very necessary in a mill of this description, where the various operations are so entirely interdependent.



PUMPING STATION, UNITED STATES REDUCTION AND REFINING COMPANY—120-HORSE-POWER SYNCHRONOUS MOTOR AND TRIPLEX PUMP.

This reduction plant grinds out about 750 tons of ore every twenty-four hours. An incidental process is the manufacture of gold bricks, which average about one per day.

To determine the approximate horse-power necessary to pump water to a given height by steam, multiply the total weight of water in pounds by height in feet and divide by 16,500. This allows for friction and steam loss.

THE DESIGNING OF TELEPHONE APPARATUS—XVIII.

BY W. A. TAYLOR.

[The series of articles on "The Designing of Telephone Apparatus," by Mr. W. A. Taylor, whose writings have appeared for some time in the ELECTRICAL REVIEW, has been resumed. These articles have excited wide interest in the telephone field, and it is with pleasure that the announcement is made that Mr. Taylor will now continue them.—ED.]

Fig. 51 is another style of relay in which the trouble from the poor contact of Fig. 50 is overcome. In this style the armature is fastened to the shell by a very thin piece of sheet spring metal, preferably German silver. This spring, S, partially supports the weight of the armature A, giving it great sensitiveness. The armature, A, is made somewhat smaller than the diameter of the shell, so that the cap, C, may be slipped over without interfering with the movement. This relay may be made in the style known as the back contact type, in which the contact stands normally closed. This arrangement is shown in Fig. 52.

These types shown have all been in general use, and in addition to these the pony telegraph relay has been used extensively. The drawback to the telegraph relay is in its size, as it requires too much space. Whatever other styles of relays are used, they are all of a similar type and need not be considered except that the windings vary. The matter of winding is of as much importance as the arrangement of the springs.

The pilot relay is a special wound relay, usually very low in resistance and with a winding which will carry a considerable quantity of current. It is usual to place this relay in the common wire of the signals or in a special local circuit of the line signaling apparatus. When any line signal is operated, if the pilot relay is in the common battery wire of this signal, the same current which operates the line signal will operate the pilot relay. This operation closes a circuit, lighting a lamp or ringing a bell or buzzer. In like manner, if the pilot relay is in the local circuit, which is closed by the line signal, this relay will operate as soon as the contact is closed. It will thus be seen that the minimum current which passes through a line signal must operate the pilot relay when it is placed in the common of the signaling relay or visual. The pilot relay must also be able to stand the current from any number of circuits

which may be in use at one time. For instance, in case the signals were operated at once, all the current would have to pass through the pilot relay. If this relay had a high winding the drop in potential around each of the line signals would be small and they would not be apt to respond to the signal. The relay must, therefore, be made very sensitive and at the same time of very low resistance.

It is considered poor engineering to place the pilot relay in the common battery wire of the signaling apparatus for the reason that there is always more or less leakage on the lines. In case of a very few lines there would not be enough leakage to operate the relay, but where there are one hundred or more the leakage in wet weather is good enough to keep the armature of the relay always pulled up. In order to avoid this trouble on lamp signal switchboards, the relay is placed in the common of the lamps. Here another difficulty arises. If there are many lamps in operation at once the voltage is cut down by the relay so as to make the lamps burn dim. If, on the other hand, but one of the lamps is in operation, the current may be insufficient to operate the relay if the resistance is low enough to prevent sacrificing voltage when many lamps are burning. It becomes necessary, in these cases, to design a relay with a very large winding space and comparatively small core so that a very great number of turns of coarse wire may be wound upon it with a very low resistance. Suppose, for example, that the resistance of the pilot relay is five ohms the resistance of one lamp is one hundred ohms, then with twenty volts and one lamp the voltages at the lamp would be about nineteen, not enough to cause perceptible dimming; if, however, ten lamps were lighted at once, the voltage at the lamps would be cut down to but thirteen and three-tenths, and all the lamps would burn dimly. It is therefore necessary to have the relay wound much lower. The resistance is usually from one and one-half to two ohms and wound with wire heavy enough to stand the current from the greatest number of lamps likely to be in use.

By far the best method is to have a contact upon the signal which closes the circuit through the pilot relay. Then the pilot relay may be wound to a high resistance and as it is the only piece of apparatus in that circuit it will not give any trouble.

It is usual to have one of these relays in each operator's position, which will light a pilot lamp whenever any line signals. This pilot lamp is placed so that its light assists in drawing the operator's attention to a call. These pilot lamps are of various sizes, from one-third candle-power to three candle-power. In front of each of the pilot lamps and nearly flush with the front of the switchboard is placed a cut glass jewel or lens. This jewel has the property of so bending the rays of light from the lamp behind it that the light may be seen from any point in the room.

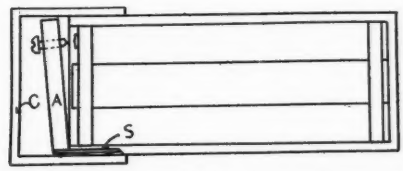


FIG. 51.

There is still another relay in the common of these pilot lamps which is used as a night bell or night-lamp signal. This relay acts in the same manner as the relays for each position, except that it is usually made to stand a much heavier current. On some boards each pilot lamp takes up three-fourths of an ampere and on one board, which is now in use, there are sixty such pilot lamps. When all of these lamps burn at once the night relay would be required to stand forty-five amperes. A relay for this purpose was made with 100 turns of No. 9 B. & S. wire on a three-eighths inch core two and one-half inches long. This relay operated with the current from one lamp and stood the current from all the lamps. The resistance was so low that the lamps were not dimmed at all.

It is a very grave mistake to use such large lamps, as the drain on the battery is something tremendous. A one-third

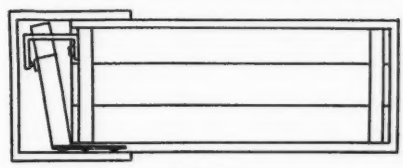


FIG. 52.

candle-power lamp will do just as well and not more than a tenth of the current is consumed. With such a great current consumption a much larger storage battery must be used.

The Supervisory Relay—The supervisory relay does not of necessity differ mechanically from the line relay or the cutoff relay. Its winding may and usually does differ materially from the other styles. The supervisory relay is used in connection with the cord circuit and is used for giving the clearing-out or disconnect signal in nearly all central-energy systems. This relay or group of relays is so arranged that a lamp associated with each cord, is lit or not lit according as to whether the line with which the cord is connected is not or is in use. As these relays are more or less in the talking circuit there are usually some very clever arrangements made so that the circuit will transmit efficiently, remain balanced and at the same time have the signals properly made. There are two classes of windings for supervisory relays. Those which are in series with the talking circuit and those which are bridged across the talking circuit. The former must of course be non-inductive while the latter are inductive. In the former kind two styles are in use, one of these has a non-inductive shunt parallel with the winding. The shunt is wound considerably higher in resistance than the winding and transmits the talking current without distortion while the current from the battery passes through the regular inductive winding. In the other styles of non-inductive relay there are two windings, one superposed upon the other. One of the windings only is placed in circuit when the signal is to operate, while when talking both windings are used; the second winding being opposed to the first. Still another type of non-inductive relay has two windings, one of which is short-circuited. Both windings must be wound parallel, however. Of course, any direct current will operate this relay, but an alternating current, such as the voice current, will induce a current in the secondary winding, which, in turn, will neutralize the inductive effect of the current in the primary winding. This latter is a slow-acting relay. It takes considerable time to pull up, and it also lets go slowly. This style of relay is also used on circuits where it is necessary for one relay on a circuit to act after another relay in the same circuit.

Stanley Electric Manufacturing Company.

The new officers of the Stanley Electric Manufacturing Company, of Pittsfield, Mass., elected at the recent meeting of the board of directors, are as follows: President, W. Murray Crane, Pittsfield, Mass.; first vice-president, Dr. F. A. C. Perrine, Pittsfield, Mass.; second vice-president, M. D. Barr, New York city; third vice-president, S. M. Hammill, New York city; treasurer, W. W. Gamwell, Pittsfield, Mass.; assistant treasurer, R. S. Murray, Pittsfield, Mass.; secretary, W. S. Westover, New York city; assistant secretary, A. G. Davies, New York city.

A SYSTEM OF ELECTRIC LIGHTING FOR CARS.[1]

BY JAMES F. McELROY.

There is a wide variation in load which axle-driven apparatus is called upon to carry in actual service. If a car is operated wholly in daytime, just sufficient current should be generated to maintain full charge in the battery or to supply battery losses. More than this amount is needless and wasteful and may be harmful to the battery plates. On the other hand, if a car is operated only at night and must be lighted for some time before it begins its run or has long and frequent stops, a very different problem presents itself. The battery then should receive its charge at a high rate and at the same time current must be generated for operating the lamps. In this case the current generated by the dynamo should be at a rate about twice that required for lamps alone. The actual demand upon lighting apparatus varies between two extremes here referred to and consequently the lighting apparatus must provide automatically for correspondingly wide variations in load.

Incandescent lamps and storage batteries require constant voltage in the supply circuit, and if a variable load is called for it is evident that we can not have a regulator controlled by the current in the mains, as in that case there will be produced a constant current at a constant voltage which will give a constant load. The variable load required must evidently be obtained by means of a constant voltage and variable current. These considerations should guide us as to the method of regulation to be selected.

The system of lighting cars which I will describe may be called a modified constant-potential system. It employs an axle-driven dynamo which is capable of operation by motion in either direction. Fig. 1 presents a view of the dynamo. It will be seen that the dynamo rests at one end upon bearings on the car axle, while it is supported by easy riding springs under the dynamo body. These springs rest upon curved supporting bars which are attached at one end over the car axle bearings and at the other end swing from pendulum supports to a cross-bar which rests upon the truck frame. The dynamo is therefore free to move with the car axle. The curved bar supports facilitate the removal of the axle and wheels when that is necessary by dropping down out of the truck frame in the usual manner.

[1] Paper read at meeting of the Boston section of the American Institute of Electrical Engineers.

They also make it easy to open the dynamo without in any way releasing the dynamo from its supports. The dynamo is driven by means of gear and pinion in a manner somewhat similar to that employed on motors of trolley cars. A wrought-iron gear case encloses the gear and pinion and is made dustproof with leather packing.

All doors admitting to parts of the dynamo requiring inspection as well as the doors for supplying oil and waste to the axle bearings close upon leather or felt packing and are held firmly to place by strong spring latches of flat steel. All doors are in this way made dustproof.

The compartment containing the reversing switch is shown at the left and in advance of the armature bearing. This switch is operated by the armature shaft and reverses the connections of the armature to the mains. A door easily accessible admits to this chamber for purposes of inspection.

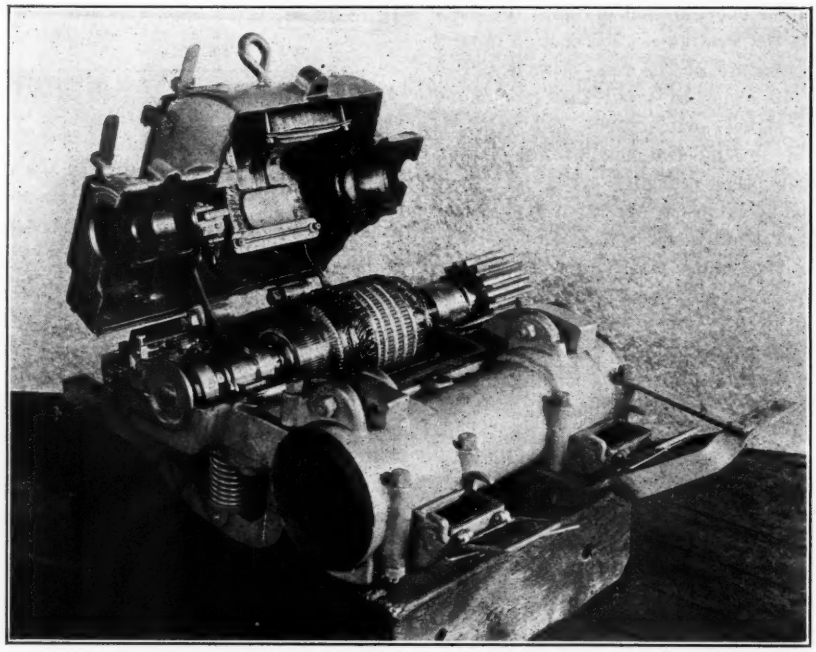


FIG. 1.—THE DYNAMO, AND APPURTENANCES—OPEN.

A storage battery is employed for supplying the lamps during stops. The battery receives its charge at all times when the dynamo is in operation and the battery is below the point of full charge. The flow of current to the storage battery and the generation of current by the dynamo are regulated through the widest variations of speed by means of the regulator shown in Fig. 2. In this regulator, a motor, through worm and gear connections, operates a rheostat which is connected in series with the dynamo fields. The motor is controlled by a compound solenoid and plunger, the plunger being connected with an arm carrying carbon contacts by which the current is directed through the motor for changing its direction of motion. To ensure the workings of the regulator under all conditions, it is necessary that the motor should be wound for large torque and low speed and be capable of operating at a voltage as low as the lowest voltage ever carried upon a battery. It is also necessary that the changes in position of the rheostat should be made at a rate not greater than the rate at which the corresponding changes will take place in the field magnets of the dynamo, otherwise the phenomenon of racing will cause a disturbance in the lights. To prevent racing we use a centrifugal governor by means of which the circuit through the motor is completed between two stationary rings which surround the motor shaft. Contact is made between these two rings by means of weighted arms which, on the starting of the motor, immediately throw out and break the circuit. The result is that the governor gives to the motor a fixed rate of motion and this rate of motion is not increased or decreased within the limits of voltage at which the motor operates. The centrifugal governor is mounted above the motor and within the perforated hood at the top of the regulator.

In the construction of this regulator the compound solenoid is placed inside an iron envelope which receives its sup-

port from the metal framework to which all of the working parts of the regulator are attached. The iron envelope increases the pull of the solenoid more than twice over by furnishing a magnetic covering through which the magnetic flux

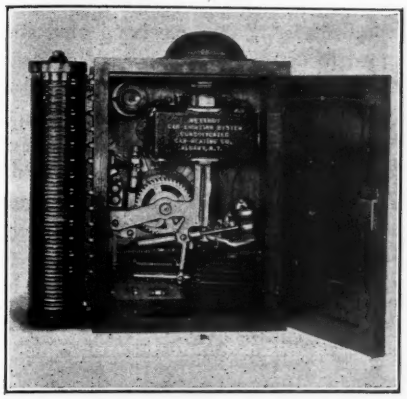


FIG. 2.—THE REGULATING APPARATUS.

is conducted back outside of the coil. At the ends the iron envelope is kept back from the plunger a distance of nearly three-eighths of an inch to prevent the envelope from creating a side pull upon the iron plunger. Longitudinal ribs are cast on the iron casing for the purpose of furnishing a path in the direction of the magnetic flux and at the same time for increasing the surface of the iron casing to permit of the ready escape of heat that may be generated in the solenoid.

The enlarged pull upon the plunger, due to the improved path for the magnetic flux, and the fact that the regulation is effected both by means of change of voltage and change of current to the battery, renders the apparatus very sensitive and positive in its action.

The switch for disconnecting the dynamo from the storage battery is operated by the motor which drives the rheostat. The return of the rheostat to the home position when field resistance is all out, opens the switch and disconnects the dynamo. In starting the dynamo, when the dynamo voltage equals the lamp voltage, the first motion of the rheostat closes the switch and connects the dynamo and storage battery together. A further rise of voltage causes the lamp resistance to be inserted step by step between the battery and lamps and the battery begins to receive its charge.

The lamp resistance is shown more clearly in diagram of connections in Fig. 3. The sections of this resistance are inserted as the voltage of the dynamo rises, causing motion of the rheostat arm from its home position. The proper fall in voltage from that required for the storage battery to the lamp voltage is thus secured. The lamp voltage is that which the storage battery is capable of maintaining when the dynamo is not in operation. As the lamps are divided into two circuits, each circuit has its own lamp resistance, which is inserted step by step by the rheostat arm.

Vestibule lamps are provided so as to give an abundance of light upon the steps and in the vestibules of a car when the train comes to a standstill. These lamps are preferably connected across the cut-out switch separating the dynamo from the storage battery. The current for the vestibule lamps therefore flows from the storage battery through the dynamo and lamps in series. These lamps are lighted solely by the difference of the electromotive force of the dynamo and storage battery. They are, therefore, lighted automatically when the speed of the train drops below twelve miles per hour and come to full intensity at very slow

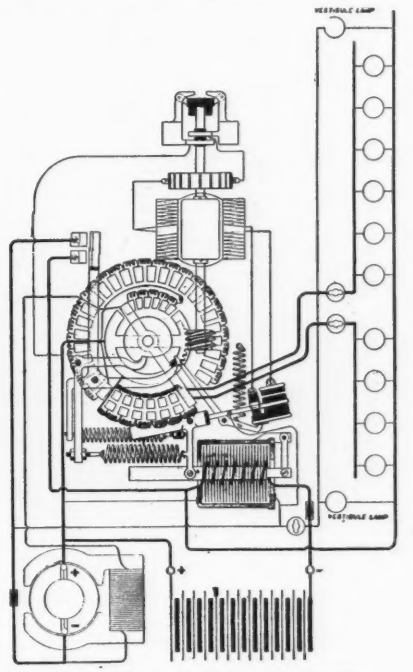


FIG. 3.—DIAGRAM OF CONNECTIONS.

speeds and during stops. As these lamps do not draw upon the lighting apparatus during long runs, they can be made of ample intensity to furnish an abundance of light over the steps of a car at the time when the steps are in use, and at the same time do not draw upon the lighting apparatus at times when the lights in the vestibules are not needed.

The motor of this regulator performs a series of operations in a prearranged order. In the act of stopping a train, the rheostat moves to its home position and cuts out the resistance in series with the field coils of the dynamo. As it approaches the home position it cuts out the lamp resistance and automatically changes the tension of the regulator spring to change the adjustment of the regulator from the voltage of the dynamo when charging the battery to the voltage of the lamps. When the dynamo voltage reaches the lamp voltage the motor opens the switch between the motor and the storage battery. A further movement of the motor opens up its own circuit so that when the car is at a standstill there is no circuit

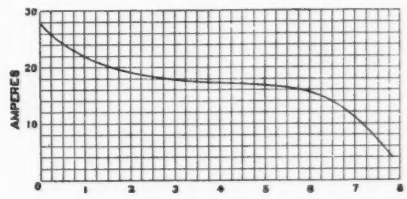


FIG. 4.—CURRENT TO STORAGE BATTERY.

through any part of the regulator or dynamo through which the current of the storage battery is wasted. However, all parts of the regulator are then in proper position so that when the dynamo current picks up and excites the solenoid, the effect upon the plunger is to first reestablish the circuit through the motor, which is done at the carbon contacts; second, it closes the circuit between the dynamo and storage battery, and then, third, a further rise of voltage of the dynamo causes the regulator to insert resistance in series with the lamps and in series with the field coils of the dynamo.

In this regulator no motion of any of its parts takes place except when necessary to meet some change in the conditions of the lighting system. When the train is running at a constant speed, the regulator is motionless. When speed increases a slight motion takes place just sufficient to introduce the proper resistance in series with the dynamo fields to maintain the voltage constant. In this way we obtain the smallest wear of moving parts and the least possible care is required to keep the mechanism in order.

I have already referred to the fact that

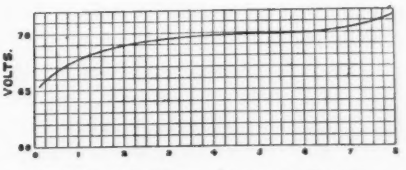


FIG. 5.—MODIFIED CURRENT CURVE.

the regulator is controlled by a compound solenoid. I will now explain more in detail the construction and connections of the compound solenoid and the reasons

for its use. By reference to Fig. 3 it will be seen that the compound solenoid is made up of two coils, one a large shunt-wound coil connected between the dynamo mains, and the other a small series coil which is connected between the main and the storage battery. These two coils act in conjunction when the dynamo is supplying current to the storage battery and are opposed to each other when the storage battery is giving out current. The compound solenoid draws the plunger against the tension of a spring. A motion of the motor always takes place when the pull of either the solenoid or the spring predominates and causes the carbon contacts to close the circuit through the motor. The total of the effects of the two coils upon the plunger is equivalent to the tension upon the resisting spring.

Now, it must be evident that when the storage battery is nearly depleted, the rush of the charging current into the storage battery through the series coil will cause the series coil to increase its pull upon the plunger and hence reduce the voltage at the terminals of the shunt coil. In this way the excessive flow of current into a depleted battery is prevented. However, as the charging operation proceeds and the counter electromotive force of the battery increases, the decreased flow through the series coil to the battery will decrease the magnetic effect of the series coil and the voltage at the terminals of the shunt coil will correspondingly increase. As the counter electromotive force of the battery continues to increase, the decrease in the flow to the battery will slowly but gradually cause a rise in the voltage on the mains. When the battery begins to gas and the voltage of the battery rises abruptly the shunt coil will assume almost the entire control over the regulator, and the current through the series coil to the battery will reduce to not over five to ten per cent of the original charging rate, this being deemed just sufficient to cause the battery to slowly gas and replace battery losses or leakages. In this condition the apparatus may be used on a car having a daylight run and with practically no load upon the dynamo after the battery has become fully charged. It is also used, without readjustment, upon cars operated wholly at night with all lights in use. It will be seen that with this simple device the charging of the storage battery is made automatic and by proportioning the number of ampere-turns of the series and the shunt coils, the charging rate may be made to follow any formulæ that the battery maker may prescribe. It will also be seen that with this method of regulation we avoid the dangers of both the shunt and the series methods of regulating the charge to the storage battery.

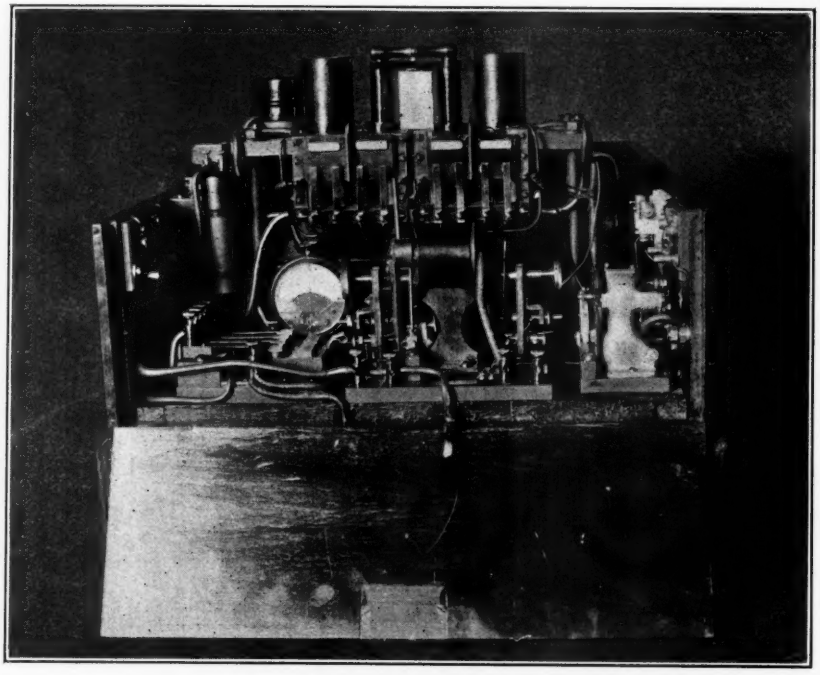
When a storage battery is being charged at constant potential, there is a heavy and destructive rush of current to the depleted battery, followed by such a reduction in flow as scarcely to be able to complete the charge. Evidently the trouble here is too great a rush of current to the depleted battery and not sufficient current as the battery approaches full charge.

When a battery is being charged with a constant current there is an abrupt rise of voltage as the battery becomes fully charged. This is so abrupt that it would be dangerous to operate incandescent lamps on the same circuit. In Fig. 4 is shown a curve of current to a storage battery as supplied by the apparatus described in this paper. In Fig. 5 the extent to which the constant potential is modified is also shown. In this apparatus we avoid the danger of the shunt method by reducing the charging rate to the depleted battery and by increasing the charging rate as we approach complete charge. We avoid the danger of the series or current method of regulating the charge to the storage battery by giving the largest rate of current when the battery is depleted and by avoiding the too high charging rate of the series method when the battery charge approaches completion. When the battery begins to gas we also avoid the abrupt rise in voltage of the charging current. We also avoid the danger of continuously charging a battery at a normal rate long after the charge of the battery has been completed.

An Electrical Ore Finding System.

The accompanying illustration shows the apparatus for locating ores, which has been used with considerable success in England.

The system consists of transmitting inductors which deliver electric waves of a definite length, and receiving resonators tuned to detect these waves and to determine their characteristics. The waves from the inductors are impressed upon the crust of the earth in any desired locality, and are radiated to considerable distances, horizontally and perpendicularly. The operator traverses that portion of the energized field to be explored for minerals, and by means of the receiving resonators constantly perceives manifestations of the waves beneath. On approaching a mineral vein or lode, the normal characteristics of the waves undergo a marked variation in intensity or direction, or both, which changes are heard in the resonators. When the resonators are over the lode these variations are greatest, and after some experience with the apparatus the operator is able to locate and define a lode with considerable accuracy. Veins or lodes which act as insulators compared with their enclosing rocks, can also be located.



THE ELECTRICAL INDICATING APPARATUS FOR LOCATING ORES.

The result of the survey made with this apparatus at the Cwmystwyth mines, in Cornwall, England, resulted in the location of several important lodes of lead and blende ore which were unknown to the operating company, but which have

since been found and are now being developed. These mines have been worked more or less for the past 1,700 years, and a vast amount of work has been done in looking for and developing lodes. The engineer of the Electrical Ore Finding Company was able to locate the important lodes just mentioned without great difficulty.

The system promises to be very useful in exploring new ground, and in indicating the direction in which future work should be carried on in old mines. The next work to be undertaken by the Electrical Ore Finding Company will probably be in the south of Spain, where prospects for successful application are very bright. This system has been developed by the well-known electrical engineers, Mr. Leo Daft and Mr. Alfred Williams. Mr. Daft is now the consulting engineer of the company in the United States, while Mr. Williams has charge of the work in England.

American Telephone and Telegraph Company.

At the special meeting of the stockholders of the American Telephone and Telegraph Company, held in New York city last week, the stockholders authorized an increase in the limit of capital from $150,000,000 to $250,000,000. This action was necessary because the present authorized limit had nearly been reached, and provision had to be made so that additional stock might be issued from time to time as required to meet the future necessities of the company. In the annual report to the stockholders, President Fish spoke of the growing necessity of adding to the capitalization of the company and showed the benefits, both to the stockholders and to the public, which would accrue from an expanded capitalization.

At the annual meeting, following the special meeting, the retiring board of directors was reelected, with the exception of Mr. John H. Cahill, in whose place the Hon. W. Murray Crane, ex-governor of Massachusetts, was elected a director. Besides the board of directors, three additional vice-presidents were elected, as follows: George M. Cumming, Thomas Sherwin and C. Jay French. The board of directors consists of the following gentlemen: Charles W. Amory, George F. Baker, Francis Blake, Charles P. Bowditch, George L. Bradley, W. M. Crane, Alexander Cochrane, T. Jefferson Coolidge, Jr., Frederick P. Fish, J. Malcolm Forbes, Henry S. Howe, Charles Eustis Hubbard, Charles E. Perkins, Thomas Sanders, Nathaniel Thayer, Theodore N. Vail, John I. Waterbury, Moses Williams.

BOOK REVIEWS.

"The Electrician Electrical Trades Directory and Handbook for 1903." Published by the *Electrician*. London. Cloth. 6½ by 9½ inches. Two volumes. 1267 and 250 pages. Illustrations, portraits, maps, charts, tables, etc. Supplied by the ELECTRICAL REVIEW at $6.00.

The twenty-first volume of "The Electrician Electrical Trades Directory and Handbook" has come to hand. This has been revised and corrected up to February 10, 1903, and is bound in two parts. Part I, under the heading "miscellaneous," contains a number of useful tables, statistics, data, etc., such as theoretical velocity, statical pressure, and horsepower for hydraulic heads, carrying capacity of resistance materials, standard specification for testing electrical machinery in Germany, notes on illumination, and statistics of the development of the electrical industries in Great Britain. Section II, entitled "Electric Lighting, Power and Traction," contains much legal matter pertaining to these industries. Information regarding telegraphs and telephones is given in a section under that title, and a section of the book is devoted to financial and municipal matters and technical colleges. The last section of part I contains a complete directory of electrical trades for Great Britain, alphabetical and classified. Part II of this handbook contains a very complete index of the electrical trades for the British colonies, Europe, Asia, Africa, Central and South America and the United States. The last section of this part gives a large number of illustrated biographical sketches of prominent electrical engineers. The big blue book has long been known as one of the most satisfactory and valuable electrical directories published in the world. While, naturally, it is largely devoted to British matters, the division for the United States is very complete. For those doing an export business it is an almost invaluable compendium of information concerning the electrical trades in Europe and elsewhere.

"The Induction Motor." Henri Boy de la tour. (Translated from the French by C. O. Mailloux.) New York. McGraw Publishing Company. Cloth. 6¼ by 9¼ inches. 200 pages. Numerous diagrams. Supplied by the ELECTRICAL REVIEW at $2.00.

This book is for the purpose of assisting those designers who have not had a thorough training in the new theory of the induction motor. The author, who is chief electrician and designer for the electrical department of the Compagnie Fives-Lille (France), gives here a complete study of the polyphase induction motor, explains at length all the peculiarities of its operation, and gives a practical method of calculation, remaining within the bounds of elementary mathematics. In the introduction by the translator, the terms in general use in designing induction motors are defined with care and exactness. The first chapter of the book takes up the revolving field, explains its generations, and discusses the effects of various types of winding upon the distribution of the flux. Chapter II discusses the action of the revolving field; chapter III, the magnetic couple; and chapter IV, the magnetizing action of the windings. Chapter V treats of resistance calculations. In chapter VII the performance of the induction motor is explained, free use being made of the general transformer diagram. The effects of various types of winding are here considered. Chapter VIII shows the practical application of the methods and formulæ deduced in the preceding chapter. The last chapter of the book explains the so-called Heyland induction motor, and explains the reactions by which the power-factor may be made unity. The book is a very welcome addition to the literature on induction motors, and will prove of great assistance to students, although it is primarily written for designers.

Dedication Ceremonies.

The dedication ceremonies of the Louisiana Purchase Centennial will be held at St. Louis, April 30 and May 1 and 2, 1903. The invitations to this interesting event are signed by Hon. David R. Francis, president, Louisiana Purchase Exposition, and Hon. Thomas H. Carter, president, Louisiana Purchase Exposition Commission. The President of the United States will be present, and a number of our most eminent citizens. The event will undoubtedly be one worthy of the One Hundredth Anniversary of the acquisition by the United States of the vast Louisiana territory.

Joint Meeting of the American Institute of Electrical Engineers and the American Electrochemical Society.

The American Institute of Electrical Engineers and the American Electrochemical Society will hold a joint meeting on the evening of Friday, April 17, at the chapel of the College of the City of New York, Lexington avenue and Twenty-third street. The place of meeting previously announced has been changed. The paper of the evening will be delivered by Mr. William J. Hammer, on "Radium and Other Radio-Active Substances, and Certain Phosphorescent and Fluorescent Substances. The Properties and Applications of Selenium. The Treatment of Diseases by Ultra-Violet Rays."

Theory of X-Ray Action on Cancer.

Many theories have been advanced as to the action of the X-ray in the various conditions for which it has been used. By some the belief is held that restitution of the tissues takes place under X-ray treatment; that is, cancer tissue becomes transformed or is developed into normal tissue. Others, taking for granted that the parasitic or bacterial theories of the origin of some of the diseases treated by the X-ray have been conclusively proven, believe that the X-ray, due to its actinic action, destroys these conditions. These theories seem rather far-fetched, however, for, aside from the lack of proof of the parasitic or bacterial origin of the diseases referred to, it does not seem probable, from observations which have been made by various investigators, that the success of the X-ray treatment in these diseases is exclusively due to any bactericidal power which the rays may possess. The following is the view taken by Dr. E. H. Grube, in the *Medical Record:* Personally, we believe the action of the X-ray is the same in all the diseases in which it has been found of value, and also that that action is most plausibly explained when viewed from the standpoint of the theory of phagocytosis followed by leucocytolysis. First, it must be admitted that, aside from whatever chemical or electrical property the X-ray may possess, the sum total of its action is that of an irritant. Now if we irritate a certain part of the body by making frequent X-ray exposures, we produce ultimately a simple focal inflammation. Inflammation means the determination of much blood to the part, hyperæmia. Due to the increased volume of blood, leucocytes accumulate in large quantities and, finally, stasis occurs, the circulation being cut off, the part dies for want of nourishment. When no suitable nutritive material is at hand there is developed a tendency toward degeneration. No doubt this degeneration is partly, at least, due to an accumulation of the products of the metabolism of cells. Primarily, then, the X-ray affects the essential tissue-forming elements of the body. The parts which are walled off decompose chemically and are either discharged or absorbed. The rapid decrease in the size of some growths under X-ray treatment also points to a more general or systemic action, probably due to stimulation of the lymphatics. The fact that nearly every case, no matter how severe, treated by the X-ray seems to improve at the beginning of the treatment, shows that it exerts an influence which is not only local but also systematic. From our personal observations upon several hundred patients we have come to the conclusion that the nutrition of the entire system is affected, through reflex action probably, and this produces a general stimulating and tonic effect. We do believe that the X-ray has established for itself a field in the therapeutics of lupus and epithelioma. Not only that, but the future will see its greatest application in the treatment of patients immediately after operation, to prevent the possibility of recurrence. The X-ray becomes a danger in the hands of the incompetent operator. We must not forget that we have a great variety of X-rays to deal with—in fact, to use a comparison, the variation in quantity and quality of X-rays obtainable with one piece of apparatus is much greater than all the varieties and qualities of tones which may be produced upon the keyboard of a piano. Again, different tissues demand different degrees of X-ray value.

Students of the American Institute of Electrical Engineers.

As has already been announced, the American Institute of Electrical Engineers has arranged to extend certain privileges to those who are regularly pursuing studies in electrical engineering. Such individuals will be designated as students of the American Institute of Electrical Engineers, and the following regulations have been adopted to cover the privileges thus extended. Students regularly pursuing electrical subjects will have the following privileges—First, the privilege of being present at all meetings of the Institute, except such business meetings as relate to the management of the Institute; second, the privilege of receiving the regular announcements and printed copies of monthly transactions; third, the privilege of purchasing the semi-annual bound volumes of the transactions of the Institute at the price of $3.50 per copy, or at such other price as may be hereafter fixed by the board of directors. The following are the conditions necessary for enrolment as a student: The application must be endorsed by one member or associate, and it must be recommended by the board of examiners and approved by the board of directors; the annual sum of $3 must be paid in advance, when the applicant will be enrolled as a student of the Institute; no student shall have these privileges for more than three years, and they may be withdrawn from any student at any time by a majority vote of the board of directors. Application should be sent to Ralph W. Pope, secretary, 95 Liberty street, New York city.

Manila's New Fire-Alarm System.

(Special Correspondence.)

A new fire-alarm system has just been introduced into Manila by City Electrician Frank Moffett, who labored long and hard before convincing Chief Hugh Bonner that it was the best.

At any rate, Mr. Moffett finally succeeded in getting the municipal board, one member of which, Percy G. McDonnell, is the correspondent of the New York *Sun*, to install the Gamewell apparatus.

Some six weeks ago the first of the material for the new system arrived, and at this writing (January 19) the two large switchboards and about all of the wires, fire and police boxes, and the small switchboard have been installed. It is impossible at the moment to give a complete and accurate description of the system because it is not yet in fighting trim.

The system consists of two direct-acting lines, one for the police, the other for fire-alarms. The police circuit has sixty boxes out of the 135 ordered, the balance being distributed judiciously throughout the city, being perhaps closer together in Binando, the Chino quarter, than elsewhere.

In New York every alarm sent out must come first from its box to the central, or headquarters, office, being then rung out by hand over the proper circuit on which are the companies that must respond to the call. In Manila, which is a city of some 300,000 population, the reverse is true. The system is purely automatic, the alarm going direct from the call box to the engine, truck or chemical engine company assigned to that particular district. When the company has gone out to the fire in question the alarm is repeated to headquarters for its records. Thus no time is lost and the possibility of mistakes on the part of operators at headquarters is completely eliminated. Of course, such a system could not be used in New York, where there are about eighty circuits averaging between forty and fifty call boxes apiece, but for a town like Manila, where the wires are comparatively few, it is ideal. Each police call is also registered after going to the station for which it is intended, thus giving the authorities a double check on their policemen, both native and American. A small General Electric motor-generator, 110 volts, direct-current, located at headquarters, supplies the energy for the line, being fed from the local electric light plant's mains.

ARTHUR STANLEY RIGGS.

Manila, January 19.

INDUSTRIAL ELECTROCHEMISTRY AND ELECTROMETALLURGY—XIII.

Notes on Progress in Europe and America.

BY JOHN B. C. KERSHAW.

The Electrolytic Treatment of Tin Slags and Ores.

In the issue of the ELECTRICAL REVIEW for March 14, reference was made in the series of notes appearing under this heading to the electrolytic methods of recovering tin from the tin-scrap and tin-cuttings found in the refuse of all large towns, and in the waste of certain factories where tin sheet is largely used. The treatment of the refuse and waste from tin smelting works is another branch of metallurgy in which electrolytic methods are at present being employed with some degree of success.

Tin is found in nature chiefly as tinstone or stannic oxide, and the ordinary metallurgical processes by which tin is obtained from this ore involve five operations; namely, mechanical sorting, calcining, washing, smelting, and refining. In the latter two operations a certain loss of tin occurs with the slags, and it is here that electrolytic methods would appear to have some chance of success. Robertson & Bense, a German firm, with works at Tostedt, is stated to be using such a method for recovering tin from the slags produced in its works, but beyond the statement that sulphuric acid is used in this process no details of it have been published. According to Danneel, the plant for working this process at Tostedt has recently been enlarged, so one may assume that the process is successful. Attempts to extract tin from its ores by electrolytic methods are likely to be less successful. The ordinary process for treating tinstone is one of the simplest metallurgical reductions, the prepared ore being simply heated with coke on the hearth of an ordinary reverberatory furnace. No electrolytic method can hope to displace this process unless it offers either greater economy or greater purity in the final product. Two electrolytic methods of treatment have been patented, but neither of these would appear to possess the required advantages. That of Bergsoe is based upon the use of a solution of stannic chloride for leaching the roasted ore, and the resultant solution of stannous chloride is then electrolyzed. This process has not, to the writer's knowledge, yet been tried on an industrial scale, and the difficulties that have wrecked the very similar Hoepfner process for extracting copper from its ores would seem to render success improbable. The second process depends upon a reducing heating of the finely divided ore with the calculated amount of carbon before leaching with a suitable solvent for the reduced metal. The resultant solution of sodium stannate, tin chloride or sulphate is then electrolyzed, and the tin obtained in the crystalline state at the cathode. Various attempts have been made to work this process, but, so far as the writer is aware, permanent success has not been attained on an industrial scale. The successful extraction of tin from its ores by wet methods is therefore a problem that still awaits solution by electrometallurgists.

The Production of Cyanides by Spark Discharges.

The success attained by the Atmospheric Products Company at Niagara Falls, in the production of nitrates from the air by the action of high-tension spark discharges, to which reference was made in these notes of February 21, 1903, lends interest and importance to some recent investigations carried out by Gruskiewicz upon the production of cyanides by a similar method.

The experiments made by this chemist were first confined to mixtures of acetylene gas, hydrogen and air. Berthelot was the first to observe the formation of hydrocyanic acid when such mixtures were decomposed by the action of spark discharges, and Gruskiewicz confirmed the observations and results of the famous French chemist. The best yield of HCN was obtained with a gaseous mixture containing five per cent acetylene, five per cent nitrogen and ninety per cent hydrogen, and Gruskiewicz then turned his attention to gaseous mixtures which could be more cheaply prepared, and offered greater chances of industrial application. The mixture of carbon monoxide, nitrogen and hydrogen, known as "producer-gas," was therefore selected for experiment, and spark discharges were allowed to act on this gas, under the conditions which favored formation of HCN.

Mixtures represented by the equation

$$3CO + 3H_2 + N_2 = 2HCN + 2H_2O$$

were first employed, but production of HCN was not noticed until the percentage of carbon monoxide had been increased from thirty-three to thirty-eight per cent. The best results were obtained by Gruskiewicz with a gaseous mixture containing 54.6 per cent CO, 24.8 per cent N and 20.5 per cent H, but the yield in this case was only equal to 0.40 per cent HCN, after submitting to spark discharges for one hour. The author believes that the formation of HCN is due to the decomposition of the carbon monoxide at the temperature of the spark discharge, and to the combination of the carbon while in the gaseous condition, with the hydrogen and nitrogen present around it.

Though the yield of HCN yet obtained is small, the process is doubtless capable of improvement in its chemical and mechanical details, and as "producer-gas" is a remarkably cheap product, it is not impossible that an industrial process for production of cyanides by spark discharges may be based on Gruskiewicz's experiments. Electricians and chemists interested in the subject are therefore recommended to study the original paper which will be found in the *Zeits. f. Elektrochemie* of January 22, 1903. Possibly improvements in the mechanical methods of making and breaking the spark-gap between the terminals of the secondary circuit (similar to those devised by Bradley and Lovejoy, at Niagara, for the apparatus used in the production of nitrates from the air) when applied to mixtures of carbon monoxide, nitrogen and hydrogen, may have equally satisfactory results in improving the yield of the desired product.

Larger Income for Purdue University.

The Indiana State Legislature, by an amendment to an existing law, has increased the state tax for the support of Purdue University, from one-twentieth to one-tenth of a mill upon the assessed value of the state. The increase amounts to $65,000, bringing the university's annual income considerably above $200,000. A specific appropriation is also made of $150,000, for providing a central heating and lighting plant and a building for the department of physics. This will leave an entire building for the use of the department of electrical engineering.

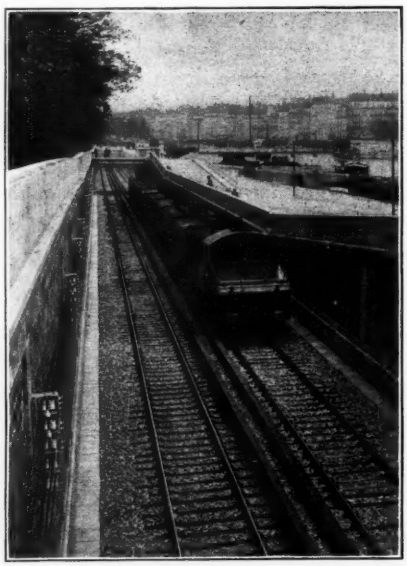
A safe and simple test for cement is to sift three or four ounces of the cement through a standard test sieve of 100 meshes per linear inch. Reject cement of which ten per cent by weight is retained on the sieve. Many Portland cements are on the market which will leave less than five per cent. A standard barrel of cement contains 3.65 cubic feet. The average weight of a cubic foot of Portland packed cement is 110 pounds.

Orleans Electric Road at Paris, and New System Which Is to Run to Suburbs.

By C. L. Durand.

THE section of electric railroad which has been installed in Paris by the Orleans Railway Company presents many points of interest, as it represents the progress which is now being made in Europe in the question of electric traction upon main railroad systems, and is one of the first lines in which electric locomotives of large power are used to draw trains made up of the standard railroad cars. The company commenced the use of the electric system with a section of road in double track, which lies along the banks of the Seine and connects the two main terminal stations of the railroad. As the operation of this section has now proved quite satisfactory, the next step is to be the construction of an important suburban road which will supply the outlying districts to the south of the city, the latter to be a four-track road and run for a distance of fifteen miles.

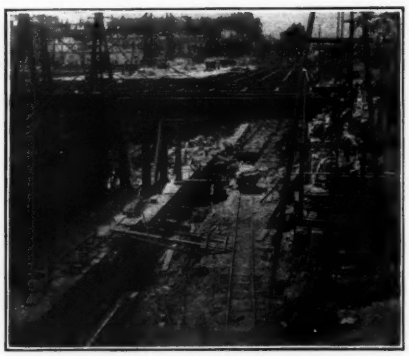
The section of the road which is now in operation was constructed in order to supply the needs of the railroad for a terminal station lying more nearly in the central part of the city. The Orleans Railroad, one of the largest systems of France, enters Paris on the eastern side and had its main terminus on the Seine at the Quai d'Austerlitz. Owing to the fact that the centre of activity has a tendency to move toward the west, the terminus of the road, situated as it is in the southeastern part, has become gradually removed from the centre, and thus lies at a disadvantage as regards the suburban traffic, especially as the passengers arriving at the station had a long distance to cover before coming to the centre of the city, which made it impracticable for them to fix a residence in the suburbs along the line of the railroad, except for those persons having their occupation in the southeastern part of the city. This fact has been well brought out in several cases where the terminal stations have been brought nearer the centre of the city, and in the case of one suburban road the traffic was thus increased forty per cent. Accordingly, the company decided to construct a terminus which should be more centrally located, and for this purpose a new depot was erected on the bank of the Seine at the Quai d'Orsay, toward the west. As the line which connects the new depot with the Austerlitz station runs nearly all the way in tunnel, and the terminal stations are also underground,



A Portion of the Track, Orleans Railroad, Paris, France.

this rendered the use of steam locomotives somewhat difficult, and the company decided to adopt the system of electric traction. After a considerable study of the subject the company sent a commission of engineers to America to examine the various systems of electric traction in use, and finally decided to adopt the electric locomotive constructed by the General Electric Company.

The present section, which has been installed by the Compagnie Française Thomson-Houston, includes 2.3 miles of double-track, standard gauge, running along the Seine between the two terminal stations, with several underground stations along the line for the use of passengers. The current for the line is generated at a main station and is supplied by a high-tension underground line to two substations.

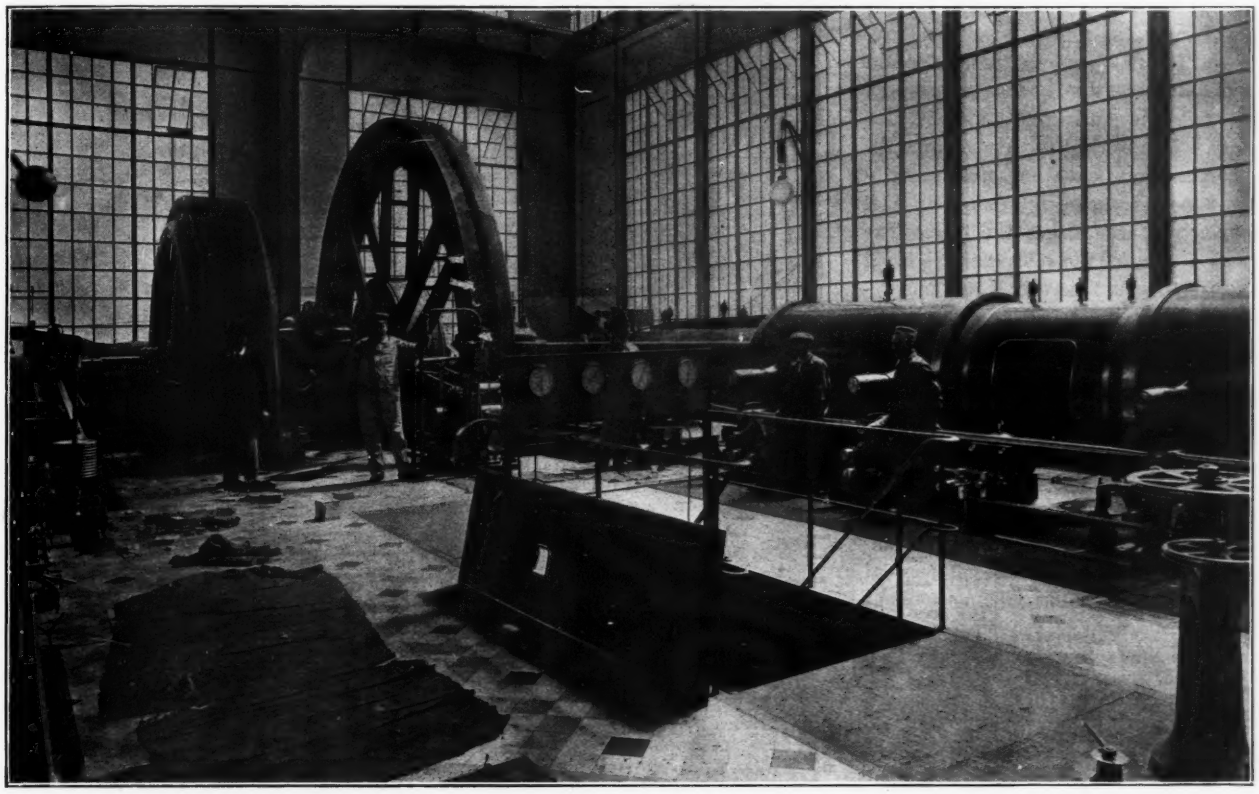


New Terminal Station under Construction, Orleans Railroad, Paris, France.

The road uses the third-rail system, taking the current from the rail by sets of contact shoes upon the locomotive. The conducting rail is supplied with direct current at 550 volts, and the current necessary for the locomotive, as well as for the different accessory services such as lighting, pumps and electric elevators, is supplied from a central generating station which is located on the banks of the Seine to the southeastern part of the city. The machines in the station, which generate triphase current at 5,500 volts and twenty-five cycles, comprise two main groups, direct coupled, each having a 1,500-horse-power engine and a 1,000-kilowatt alternator. In most cases the three-phase current is transformed into continuous current, either in the station itself or in two substations which are situated at each end of the line, which supply the lighting and motor circuits, while the triphase current after being transformed to lower voltage is used directly for operating the pumps at the depots and the generating station.

The steam is supplied by a battery of eight multitubular boilers of the Babcock & Wilcox type, each having 220 square yards heating surface, and combined with a set of Green economizers having 500 square yards heating surface, operated by electric motor. The boilers can supply in normal running 4,800 pounds of steam per hour and this can be increased to 6,000 by a change in the firing. The boilers are fed by two steam pumps with compound cylinders, direct acting, which can supply 4,000 gallons of water per hour. The pumps are arranged so as to send the water through the economizers or directly into the main supply pipe of the boilers. The water of the Seine, which is used for the condensers of the station and also for the steam locomotives of the road which take their supply here, is elevated by two centrifugal pumps of 150 gallons capacity per hour and two similar pumps of 100 gallons capacity. The first pair lifts the Seine water to a reservoir which supplies the condensers of the station engines, while the second set of pumps takes the water from thence to the reservoir used for the locomotives. All the pumps are

operated by three-phase motors of the asynchronous type. The engines are of the Corliss pattern, furnished by the Dujardin firm. They are triple expansion and can give 1,500 horse-power, running at seventy-five revolutions per minute. They carry flywheels weighing thirty-seven tons, and have an improved governor which secures a regular running. The engines can work either on condensation or free exhaust. The first cylinder has 24.4 inches diameter, the second thirty-seven and the other two forty-two inches, with a common stroke of sixty-six inches. An arrangement of piping which connects the cylinders with each other permits of suppressing the high-pressure cylinder and to work in ordinary compound, or one of the two halves of the engine may be used alone in case of accident to the other half. For the exciters, two smaller engines are used, one of thirty-five horse-power and a second of seventy horse-power. These engines are of the upright pattern and direct coupled to the exciter.



CENTRAL STATION, ORLEANS RAILROAD, PARIS, FRANCE.

The two main generating groups of the station have alternators of the General Electric pattern, giving 1,000 kilowatts. These machines are direct coupled to the engines and give three-phase current. They are of the internal revolving field type, having forty poles surrounded by the fixed armature which forms the body of the machine. The engraving shows one of the main groups with the cross-compound engine, the alternator being mounted in the middle. At the normal speed of seventy-five revolutions per minute the alternators give a current of 5,500 volts at twenty-five cycles. The alternators are calculated so as not to heat above forty degrees centigrade over the ordinary temperature after a ten hours' run at full load, and can support an overload of twenty-five per cent during half an hour or a fifty per cent overload for five minutes. The exciting current is furnished by two direct-current machines, one of twenty and the other of forty kilowatts, giving 125 volts. Besides the principal groups, the station has two direct-connected sets which are used for the lighting circuits, consisting of two synchronous motors of 125 kilowatts which take the three-phase current of the alternators; the motors are coupled to direct-current machines of 500 kilowatts, giving 500 volts. A number of smaller three-phase motors are also used for driving the pumps of the station. For the three-phase motors the voltage of the alternators is first lowered by transformers.

The road employs two substations, one of which is located at the Austerlitz terminus and the second at that of the Quai d'Orsay. The two stations are exactly similar in disposition. One of the substations is shown in the engraving. They contain two distinct sets of machines, one being used for the electric traction and the other for the various lighting circuits. The high-tension, three-phase current from the generating station is brought to the substations by insulated and armored cables laid underground. The cables have three conductors of seventy-five square millimetres section. The circuit running to the Austerlitz terminus, which is nearest the central station, is 2.1 miles long, and that which passes to the second terminus is 4.8 miles. The primary circuits are doubled throughout so as to avoid any interruption of the current, which might be caused by an accident to the underground cables. For the lighting circuit, each substation is provided with two motor-generator sets of 100 kilowatts each and two equalizing machines for the lighting circuit, which is laid out on the five-wire system. The apparatus used for the traction circuits includes two rotary converters of 250 kilowatts each and six transformers of ninety kilowatts capacity, which are cooled by two electric fans. The rotary converters use two inductance regulators and two reactive coils. The station contains also a battery of accumulators. The rotary converters are designed to transform the alternating current (supplied by the transformers at 350 volts) into direct

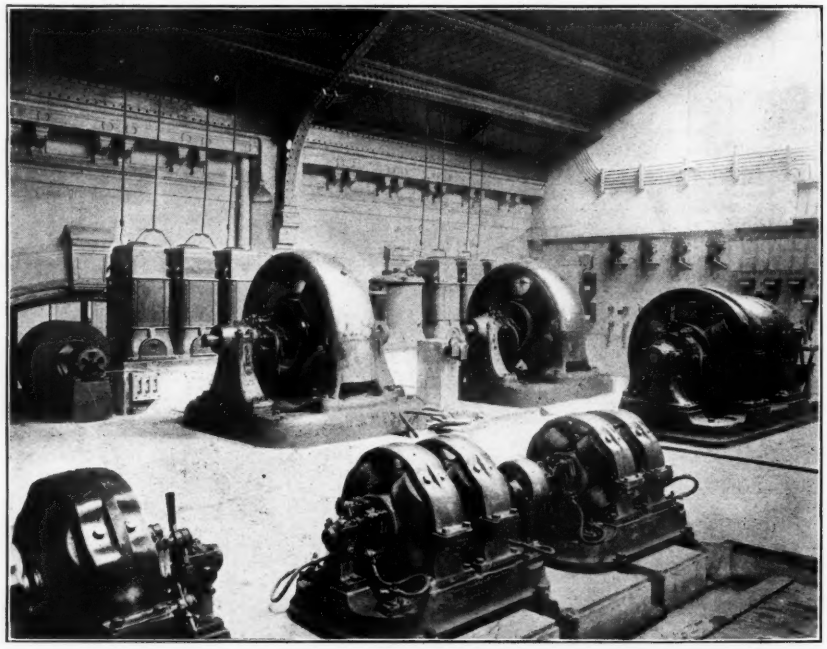
current at 550 volts for the motors of the locomotives. The rotary converters are six-pole machines, which work at 750 revolutions per minute. The lowering transformers, of which there are six, are designed to reduce the main voltage from 5,500 to 350 volts. Their normal capacity is ninety kilowatts. They are of the air-cooled pattern and are ventilated by fans driven by small electric motors.

The battery of accumulators is used for different purposes. In case the machines stop during the day the battery can supply the traction circuit during a certain time. It is also used for the night service, after the machines have been shut down, to supply the late trains. Besides assuring the lighting of the stations and line during a shutdown, the battery is also worked in parallel with the rotary converters and thus gives security against sudden loads, this being in fact its principal use during the day. The battery in each of the substations is made up of 260 elements, having 1,100 ampere-hours capacity on a one-hour discharge. Each cell contains eighteen positive and nineteen negative plates and weighs seventy-seven pounds in running order.

The type of locomotive used on the Orleans system will be observed in the different engravings, one of which shows a locomotive drawing a train of railroad cars of the standard pattern, while another photograph shows the end view of the locomotive with the rubbing contacts and the disposition of the third rail. A third view shows the locomotive with its train in the interior of the terminal station. The locomotives are formed of a body, composed of steel plates, resting upon two trucks. The main side beams of the trucks, of forged steel, rest upon the axle boxes by springs, and the beams support the pieces carrying the pivots also by means of springs, so that the system affords a double elastic suspension between the body and the axle. The locomotive measures thirty feet in total length of body. The total height of the locomotive is eleven feet four inches, and the body is mounted four feet eight inches above the rail level. The distance between the centres of the two trucks is fifteen feet ten inches, and the axles of the trucks are seven feet six inches apart. The total weight of the locomotive is about fifty tons. While drawing a train of 330 tons (not counting the locomotive) they can start without difficulty on a 1.1 per cent grade, and can take such a train from the Austerlitz to the Quai d' Orsay terminal, a distance of 2.3 miles, in seven minutes. The tapering portions in the front and rear of the locomotive are designed to receive the starting resistances and the connections for the cables. In the centre is placed the engineer's cabin, which contains the various controlling apparatus, the safety appliances and the instruments. The cab is eight feet four inches long and has a central door with a window on each side, and two windows in the front and rear, thus giving an outlook from all directions, and at the same time the cab can be entirely closed by the sliding doors and panels.

On the trucks are mounted four motors, each of which drives an axle by single reduction gearing. The motors are of the G. E. 65 type, and have a capacity of 125 kilowatts each, taking from 300 to 350 amperes in the usual running. The controller for operating the locomotive is mounted in the centre of the cab, so that it can be turned in any direction. By the continuous manœuvre of the handle from the position of full stop to that of highest speed, the motors are first connected by groups of two in series, the circuit containing also the starting resistances. The latter are then gradually thrown out of circuit as the speed of the train becomes accelerated. Then the two groups of motors are connected in parallel with the resistance again in circuit to avoid an excess of current. The resistance is then thrown out gradually, so as to keep the current practically constant until the period of starting is finished. By reversing the field the locomotive is given a back movement. The cab also contains, besides the various measuring instruments and switches, an air compressor which is driven by a small electric motor and used for supplying the air-brakes.

The current is, as usual, brought to the locomotive by a third conducting rail, which is placed at the exterior and alongside the track. In some cases, however, on various portions of the track where crossings occur, as well as at the entrance of the Quai d'Orsay terminus, the current is taken from a rail placed in the middle of the track, or again by an overhead line. To provide for the three methods, the locomotives have six rubbing contact shoes which are placed three in front and three in the rear, for the conducting rails, while they also have a contact for the overhead wire which is placed on the roof of the locomotive, and may be distinguished in the engravings. The latter contact is formed of a hinged parallelogram provided with springs and carrying at the top a T-shaped rubbing piece which is pressed against the overhead wire. The locomotives are also provided with the various accessories which form part of the standard locomotives of the Orleans system, such as couplings, sand boxes, signal lights, and air-brakes.

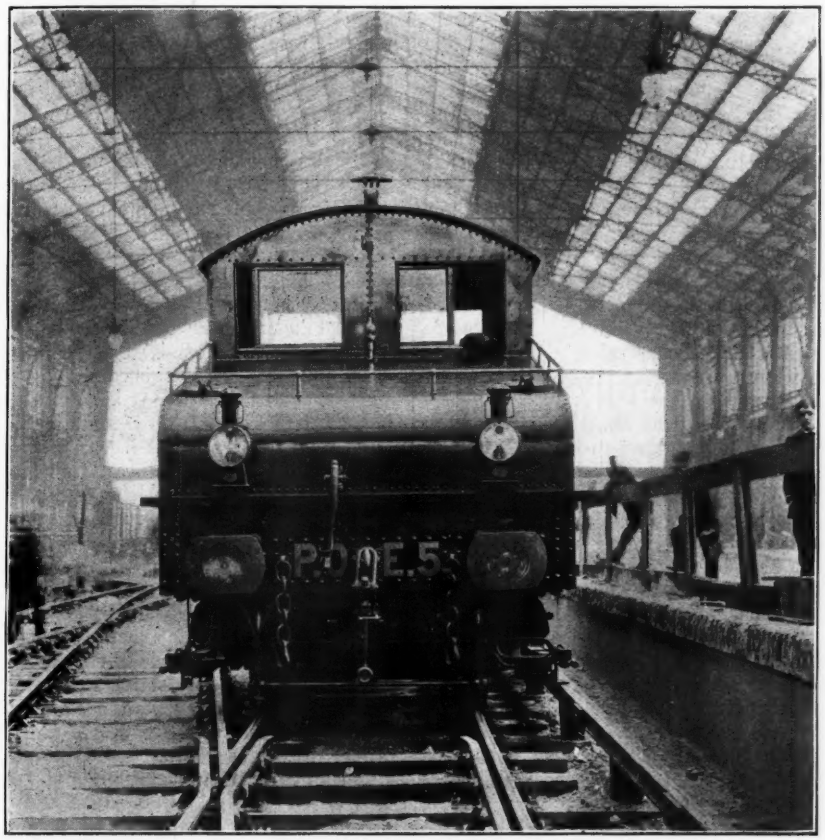


THE SUBSTATION, ORLEANS RAILROAD, PARIS, FRANCE.

The line follows the left bank of the Seine over its whole length, starting from the Austerlitz depot, which is the terminus of the steam railroad, and running to the centrally located depot which has been erected on the river bank at the Quai d'Orsay. The new line follows the general trend of the river, passing around the abutments of the bridges by short

curves, some of which have a radius as low as 600 and even 480 feet. The track is laid at the normal water level of the Seine and the water which penetrates into it is taken off by pumps, which are placed at the lowest parts. After leaving the Austerlitz depot the road descends by a 1.1 per cent grade, passing under the buildings of the depot and the Place Walhubert which adjoins it, and then runs in a tunnel following the river as far as the Quai St. Bernard, a distance of 1,460 feet. At this point the road comes out of the tunnel and follows the river in a wide cutting, as will be observed in the engraving, which shows the double track with the two third rails in the centre (partly protected by a wood covering) and a train of railroad cars drawn by a locomotive. The cutting is formed artificially by the Seine embankment wall on one side and a wall which has been erected on the side next the river. The track thus lies below the level of the street and the various bridges pass over it. The line thus proceeds as far as the Sully Bridge and then runs underneath the embankment itself, and for the rest of its course it is installed in a subterranean gallery which is lighted on the side next the Seine by a number of openings or windows which serve also to ventilate the tunnel. To provide for the passage of the line the Seine embankment over this portion has been entirely transformed, which involved a considerable amount of work, and instead of being formed as before of solid ground which upheld the street, with an outer retaining wall, at present the street is upheld by a series of cross-beams between which is built a brick vaulting, forming the roof of the gallery, while the outer retaining wall has been replaced over the whole distance by a new wall which contains the openings for ventilation.

At the underground stations on this part of the road the gallery is widened, allowing for a station platform on each side of the track. The stations are reached from the street by staircases, which are built into the masonry. One of the most important constructions of the new line is the immense terminal station which has been erected at the Quai d'Orsay, forming one of the largest depots in the city. It covers an area of 40,000 square yards and has been designed according to the most modern ideas. The absence of smoke, which results from the new method of traction, allowed the interior of the station to be arranged in a more attractive and ornamental form than is generally the case. This station will be described in a succeeding article; it is the first example in Europe of a large depot built in two stories in which the tracks are laid at a lower level. The whole space of the underground portion is occupied by the tracks, the station platforms and a few of the offices. The main halls for the passengers are established at a height of twenty feet above the level of the tracks and on a level with the streets surrounding the station, the street in front running along the embankment. The floor of the upper station is upheld by cross-beams which are supported on iron columns. The station contains sixteen tracks, of which twelve are for the use of passengers, and have an elevated sideway between each pair of tracks, so that the passengers can enter the cars on a level. The first six tracks next the Seine are laid out so as to be further extended along the river beyond the depot, while the remaining tracks end at the depot and the locomotives or cars can be transferred from one track to the other by a rolling carriage which passes across the ends of the tracks and is built to carry a load of fifty tons. The rolling carriage is operated by an electric motor. The underground portion is connected with the second story by fourteen staircases and fifteen electric elevators, besides inclined planes for the transfer of baggage. Against the station proper is built a terminus hotel which conforms to the general design of the building and contains 350 rooms. The depot and hotel contain as many as thirty-two electric motors of different sizes, which are used for operating the elevators, pumps, etc., while the electric lighting, by arc and incandescent lamps, is carried out on a large scale.



END VIEW, ELECTRIC LOCOMOTIVE, SHOWING CONDUCTOR SYSTEM, ORLEANS RAILROAD, PARIS, FRANCE.

The new line has met with great success and the suburban traffic has increased considerably since its use. No difficulty has been experienced in the operation of the road. The Orleans line is one of the most important examples in France, and in fact in Europe, of the application of electric traction to main railroad lines by the use of electric locomotives, and contains besides some special features in the details of its operation, such as the use for the first time in Europe of rotary converters working in parallel with accumulators, as well as the use of engine-driven alternators working in parallel for supplying an electric railroad line whose load is extremely variable. The system uses motors which are among the most powerful in Europe for electric trains. Although the present section is not a long one, the road is likely to become much more important in the near future, as the company now proposes to extend the tracks for a distance of fifteen miles into the suburbs, running as far as Juvisy, and there expects to secure a large suburban traffic. It is proposed to run a four-track road over this portion, and arrangements are now being made for the execution of the project. The new part will involve an increase in the electric equipment, as well as the erection of two new substations. A number of new electric locomotives are to be built, and it is expected to reach a speed of fifty to sixty miles an hour. Besides the locomotives, a number of motor-cars are to be used, containing a motorman's cab at each end, with the remainder of the car used for passengers, somewhat like the cars now used on the Paris Metropolitan.

The Midway Station of the Pacific Commercial Cable Company.

While there is not very much being heard at present of the progress of work on the Pacific cable, a lengthy description of the landing and laying of the shore end of which at Honolulu was given in the ELECTRICAL REVIEW of January 10, the work is going along with the greatest speed. One part of the original specifications, and a clause which was particularly emphasized by President Roosevelt, was that is should be an all-American cable. This has necessitated the cable touching on only American territory, and while this has wrought a little difficulty, the original idea is being strictly adhered to. The New York *Sun,* Sunday, March 29, publishes the following story in connection with this contingency:

When the surveys were made, it was found that it would be too expensive and pretty hazardous to lay the cable from Honolulu clear through to Guam without a midway station. There were plenty of islands between the Hawaiian group and Guam, owned by various foreign governments, any one of which would have been only too glad to give the cable company the necessary concession to land the cable and erect a cable station.

The handiest of all the islands between Honolulu and Guam would have been the Marshall Islands, owned by Germany. The German Emperor was not only quite willing to let the company appropriate any one of those islands for a cable station, but let it be known to the company that it would be a very nice thing all around if one of the islands was taken.

President Roosevelt would not tolerate the idea of the cable touching any land between San Francisco and Manila, other than land owned by the United States, and so an American island had to be found. The only other land in that particular part of the world owned by our government was the Midway Islands. These islands, were they on a straight line between Honolulu and Guam, would be about equidistant between the two. The islands are, however, considerably to the north of both Honolulu and Guam. They were the only available territory, though, and so the cable station had to be put on one of those islands.

Probably not many persons in these parts know very much about the Midway Islands. The name is rather pretentious, but as a matter of fact the group consists of just two small islands, and both are about as barren as the Desert of Gobi. One of the islands is called Green Island, because as many as four skimpy, sickly-looking shrubs are to be found growing on one of the sand dunes. The other island is Sand Island, and its name doesn't belie it. So far as anybody has ever discovered, not a living thing ever allowed itself to grow there. That is the piece of land which has been selected for the cable station. Sand Island was selected rather than Green Island because the shore approaches were better.

So far as the memory of man runneth the only useful purpose that Sand Island ever served has been to furnish a nesting place for certain birds of rare plumage which wing their flight from one island to another in the Southern Pacific. The plumage of the Sand Island birds has always had a market in Asiatic ports, and some of the half-civilized tribes of neighboring islands have made it their business for many years to visit the island every now and then on a bird-slaughtering expedition.

When after the death of John W. Mackay his place had been taken by his son, Clarence H. Mackay, the latter's attention was called to the Midway cable station proposition, and it was suggested to him that the company might find some difficulty in colonizing the island sufficiently for cable purposes. After young Mr. Mackay had gone over the whole Sand Island situation, he realized that the company would not only have to find men who were willing to take up their abode on a barren island in the Pacific for a reasonably long period, but that every pound of provisions consumed by the colonists would have to be carried there, and in the beginning every ounce of water drunk must also be conveyed to the island, because at present there is no sweet water on the island.

Furthermore, the gentlemen who have been in the habit of dropping down to Sand Island for the purpose of bird shooting during the past century or two have not been regarded as human beings of thoroughly domesticated habits. Some of them have been known even to so far forget themselves as to kill and eat a fellow man. When that phase of the situation was contemplated it was seen at once that the island would not only have to be colonized and fructified and provisioned, but it would also have to be fortified.

"Nice island, that," said young Mr. Mackay one day, after he had gone over the situation with Mr. Ward, the vice-president of the company. "Wouldn't it be pleasant if all our cable stations were like that? However, we have undertaken the job, and we'll have a cable between San Francisco and Manila that touches only all-American territory or we'll know the reason why."

Sand Island is about three-quarters of a mile long and half a mile wide, so that the work of fortification will not be particularly difficult. By a recent decision of the government at Washington the cable company will not be bothered with the fortification. The Midway Islands have been put under the jurisdiction of the Navy Department, and such fortifying as they may need will be attended to by the Secretary of the Navy.

The laying of the Honolulu-Manila section of the cable will begin early in May. The cableship will sail from London early in April, and as soon as it gets to Manila the work of laying that section of the cable will begin. The section from Manila to Guam will be put down first, thence the cableship will proceed to Sand Island and from there to Honolulu. About the same time that the cableship sails from London a colonizing party, so to put it, will leave San Francisco for Sand Island. The party will be made up of about fifteen men, including the superintendent of the Sand Island station, three or four telegraph operators, some electricians, a few laborers, a doctor and a small hospital staff.

The expedition of the colonists will be much more formidable in its outfit than that of the cableship. They will carry with them a quantity of canned goods, medicines, bandages, surgical appliances and general hospital stores, together with tents for temporary use and the materials for building a permanent cable station and houses for the crew. The government reports have it that water—character and constituency not very well established—has been found on Sand Island by digging ten or fifteen feet below the surface. It is suspected that this water is sweet water, but that is not definitely known.

The colonists will take with them a well digger and the necessary paraphernalia to equip a few drive wells. It is not believed, however, that the well digger will be able to take any such liberties with the bowels of Sand Island as he might take with the bowels of the earth in the United States. An artesian well, 50 or 100 feet deep in this country, is just a plain, ordinary, everyday kind of a well. It is feared that if they undertake, on Sand Island, to push a well point very far toward the centre of the earth, they will strike the Pacific Ocean before they have pushed a great way, and get instead of sweet water an upflow of old ocean.

Not only is this possibility feared, but it is also believed that water which can be found so near the surface as ten or twelve feet will become easily exhausted. If that be true, then it wouldn't take many wells, sunk into an island half a mile wide and three-quarters of a mile long, to exhaust the water supply. In that event, of course, fresh water would be either a matter of importation, or it would have to be obtained by the distillation of sea-water.

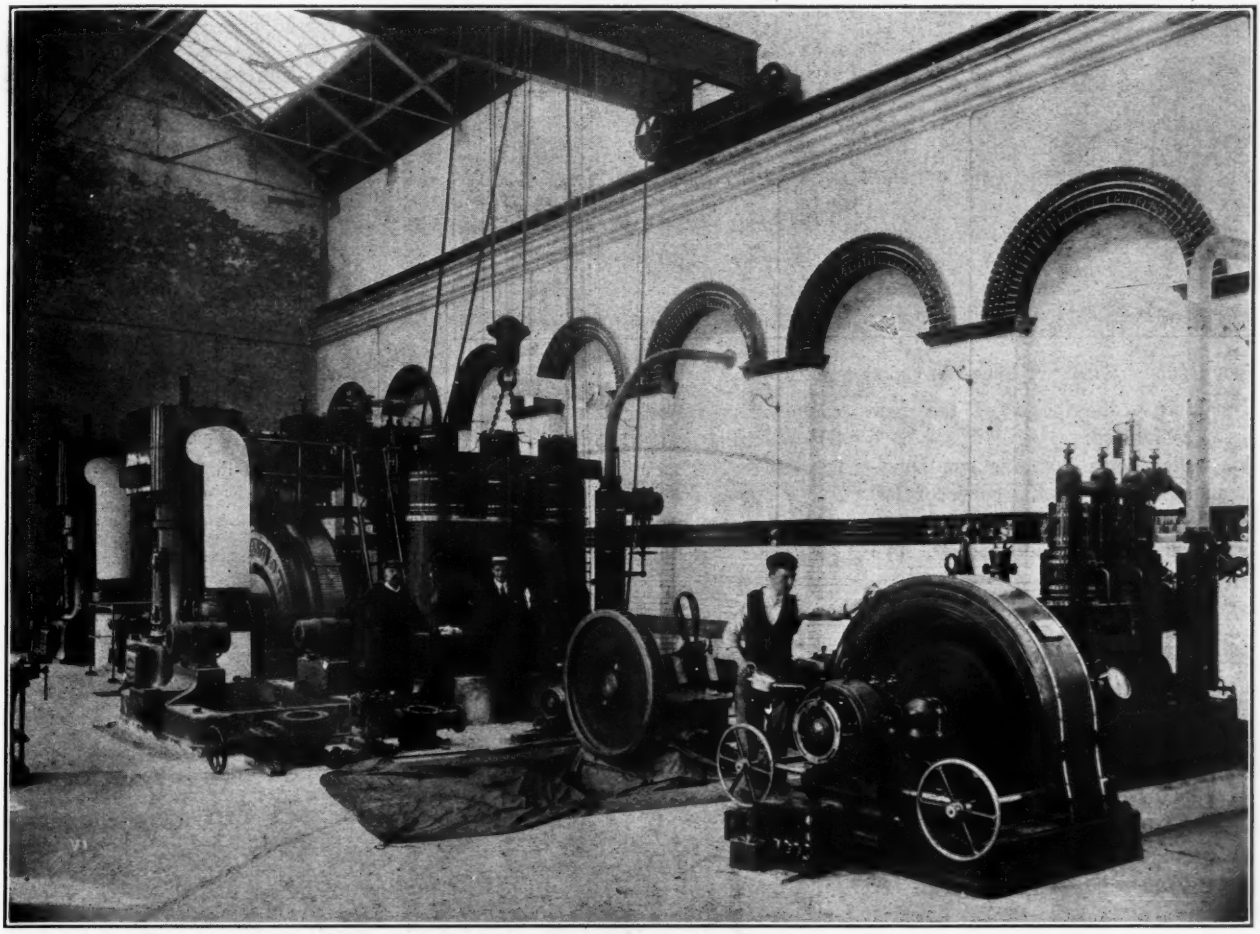
The company has already plenty of volunteers for its first station crew for Sand Island. How long they will be willing to stay and whether there will be any great amount of difficulty in getting a relay for the first crew are problems for the future, and the company is quite willing, under the circumstances, to let the future take care of it.

Unless, however, Sand Island is past all redemption, it is quite within the possibilities that in a few years it may have become one of the loveliest spots in the Southern Pacific. As soon as the first cable crew has established itself, the company intends to begin the importation to the island of the best soil to be found in all that region of the Pacific. If anybody out Sand Island way has three-quarters of a square mile of A No. 1 soil for sale at reasonable terms, he ought to get into communication with Mr. Mackay or Mr. Ward as soon as possible.

The New Eastbourne, England, Electricity Supply Works.

By A. Webster.

THE opening of the new electricity supply works at Eastbourne may be regarded as a sort of climax to a system which was started in the earliest days of electricity supply in Great Britain and has gone through all the successive changes in design of plant. The majority of the changes have been carried out in the old original works, but the demand has now risen to such proportions that it was deemed more expedient to erect a totally new structure and practically start *de novo*.



FIFTY-KILOWATT DAY LOAD PLANT—EASTBOURNE ELECTRICITY WORKS.

Eastbourne boasts the honor of being the first town on the south coast of England to have a supply of electricity for public lighting, this important event happening in September, 1882. The undertaking was then in the hands of a company, which had a small station containing a Brush arc lighting dynamo, and a combined boiler with engine underneath. This structure was of galvanized iron, but in 1884 the site which has just been abandoned was secured, and additional engines and alternating-current dynamos were installed, as the undertaking progressed, until the plant consisted of various types of machinery, few of which were up to date. At different times there have been in the station undertype engines and boilers driving by means of leather belts on to a countershaft, from which were driven Brush arc light dynamos and alternators. Then followed a horizontal compound condensing engine, driving by belts on to a second countershaft, off which were driven Elwell-Parker alternators. The next extension was a 250-horse-power horizontal engine, driving, by means of ten cotton ropes, a 100-kilowatt Lowrie-Hall alternator. Then followed the introduction of direct-coupled units, of 50, 150 and 200-kilowatt capacity, respectively. The system was a high-pressure one, with transformers in consumers' houses. Vulcanized rubber cables drawn into cast and wrought-iron pipes laid under the streets, were employed, but owing to the deterioration of the rubber insulation many breakdowns happened and caused much inconvenience.

In the year 1899, the corporation was anxious that the electric supply business should be in its own hands, and, rather than introduce a competitive business with the one already described, and which was in the name of the Eastbourne Electric Lighting Company, it approached the latter concern and finally acquired the undertaking on January 1, 1900. The system was at once thoroughly overhauled, and extensions found necessary, and, on the advice of the consulting engineer, Mr. W. C. C. Hawtaque, it was decided to build new works; *viz.*, the ones illustrated herewith.

These new works were commenced in 1901, and completed in June, 1902. Temporary plant was erected before the roof was fixed, this consisting of two 750-

horse-power vertical engines, each attached to 400-kilowatt, alternating-current dynamos of Messrs. Ferranti's manufacture, and two Stirling water-tube boilers, each evaporating 12,000 pounds of water per hour.

FOUR-HUNDRED-KILOWATT FERRANTI GENERATOR SET—EASTBOURNE ELECTRICITY WORKS.

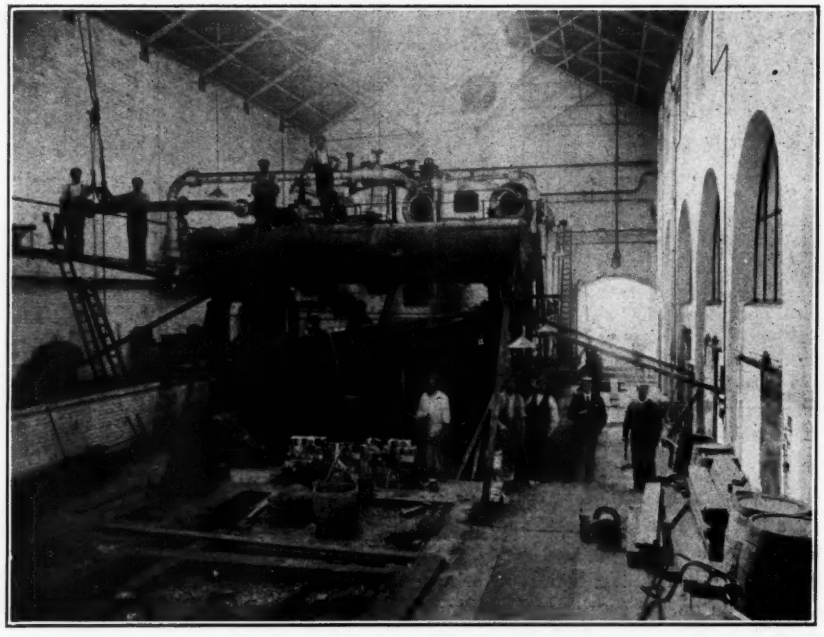
A complete description of the new works is as follows:

The boiler house contains one Davy-Paxman tubular Economic boiler of 160 horse-power, one Babcock & Wilcox water-tube boiler of 260 horse-power, two Hornsby water-tube boilers of 105 horse power each, and two Stirling water-tube boilers of 330 horse-power each. The Economic and Hornsby boilers were removed from the old works. Superheaters are fitted to all the others, which give about seventy per cent superheat. The coal bunkers are opposite the boilers, and at one end of the bunkers the pump room is situated. This latter contains a Weir pump of 3,000 gallons per hour capacity, a Worthington pump of 1,800 gallons per hour capacity, and a Pearn flywheel pump of 600 gallons per hour capacity. Attached to the pumps are small reagent pumps, for use in pumping the reagent used in softening the feed water into the feed-water heater and purifier. Over the pump room is a 16,000-gallon storage tank, and a 2,000-gallon hot well tank. A Green's 160-tube economizer is in another building, at the base of the chimney. The scrapers which remove the accumulated soot from the tubes are driven by an alternating-current motor.

The engine house plant consists of the two 400-kilowatt Ferranti engines and dynamos already mentioned in the temporary plant; one 200-kilowatt set composed of Willans engine direct-coupled to an alternator manufactured by the Electric Construction Company; one 150-kilowatt set composed of Davy-Paxman engine and Electric Construction Company's alternator, and a fifty-kilowatt set composed of a Willans engine and Electric Construction Company's dynamo. The three last mentioned have all been removed from the old works, and the dynamos rewound for the change of frequency from eighty-three cycles to fifty cycles. In the Ferranti plants, the exciter to each alternator is driven by ropes from a pulley on the main shaft, and on each of the other sets the exciter is attached to the end of the alternator shaft.

A view of the switchboard is among the illustrations. It is on a raised platform at one end of the engine room, and is reckoned as safe from the risk of a person receiving a shock as it is possible to make one. It is only six feet six inches by six feet two inches, and controls the five alternators, with their exciters, and five feeder circuits, the regulating resistances for keeping the pressure constant being in a basement immediately under the board, and worked by hand-wheels in front of each dynamo panel.

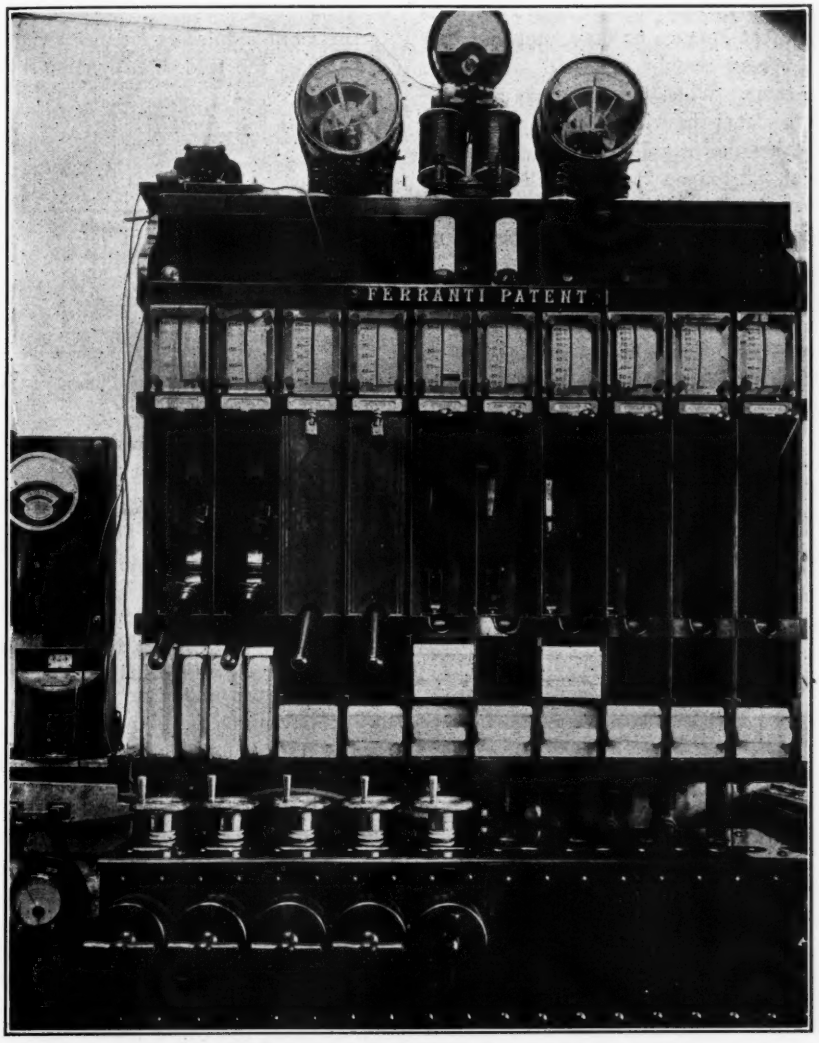
Simultaneously with the construction of the new building, an entirely new system of high-pressure cables was laid from the new works to a series of underground transforming chambers, in which were placed the transformers which feed the low-pressure distributors, all the small transformers being, of course, removed from the consumers' premises. A supply was commenced from the new works on June 10, 1902, and the work of changing over upward of 700 consumers' connections from the old supply to the new was proceeded with. During this time both generating stations had to be kept running, but on July 24, 1902, the old plant was finally shut down. The supply from the old works was at 1,800 volts, and delivered at a pressure of 100 and 200 volts at eighty-three cycles.



HORNSBY BOILER UNDER ERECTION, EASTBOURNE ELECTRICITY WORKS.

On the new system the generating pressure is 2,000 volts at a frequency of fifty cycles, which necessitated the re-

winding of all the old alternators, as already mentioned. The 2,000-volt current is carried from the works into the town by means of four paper-insulated cables laid on the solid system filled up with pitch compound. From these four cables, nineteen underground substations are fed, where the current is transformed down to 200 volts, which, in its turn, is then fed to the consumers by means of concentric paper-insulated and single rubber-insulated cables, laid solid or drawn into iron pipes. Concentric cables will eventually replace the single cables.



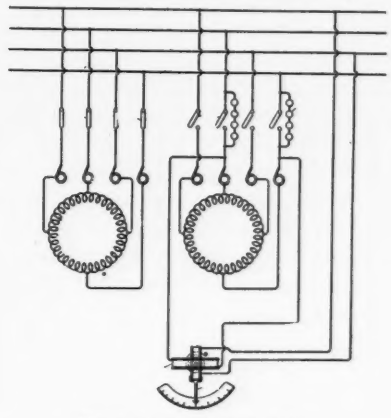
FERRANTI HIGH-PRESSURE SWITCHBOARD, EASTBOURNE ELECTRICITY WORKS.

The public arc lighting system has been entirely remodeled, and the old Brush series arc lamps have been replaced by long-burning, double-carbon arc lamps, taking six feet of carbon and burning for forty hours without being trimmed. There are thirty-three of these lamps along the parade in two circuits supplied from constant-current transformers with moving coils. Each lamp has a new type of automatic cutout switch placed in the base of the post, together with the windlass of the raising and lowering gear. In the main streets there are sixty-six more of these lamps, each supplied through a transformer and double-pole switch fuses from the 200-volt distributor. In one thoroughfare, five of the lamps are suspended over the centre of the street from span wires attached to steel posts on either side. The arc lamps and all the accessories, including the transformers, were supplied by the Gilbert Arc Lamp Company, whose lamp has been illustrated in the ELECTRICAL REVIEW in connection with the electric lighting of Victoria Embankment, London.

The use of electricity for the purposes of heating and motive power is rapidly extending in Eastbourne, there being a large and increasing number of radiators and small motors connected to the mains. In conclusion, I would record my thanks to the consulting engineer, Mr. W. C. C. Hawtaque, for the photographs, and to the resident engineer, Mr. J. K. Bridges, for affording the material for this article.

Electrical Patents.

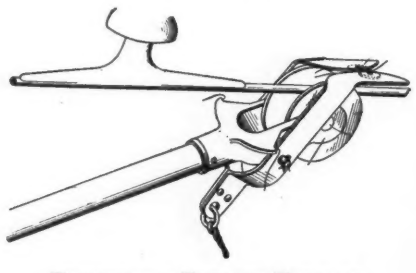
The General Electric Company controls a patent of recent issue granted to Mr. Jonathan E. Woodbridge, of Schenectady, N. Y., on a synchronism indicator, which is described as follows: The invention relates to the synchronizing of alternating-current machines, and comprises certain improvements for determining the proper moment for throwing machines in parallel with much greater accuracy than is obtainable by the methods now in use. It is the common practice to compare electromotive forces derived, respectively, from the machines to be synchronized, these electromotive forces being either in phase with each other or in opposition when the machines from which they are derived are in proper phase relation for connecting them in parallel. The indications due to the resultant electromotive forces in these cases can not be read with such accuracy as is in many cases necessary. Thus, when the electromotive forces are in phase with and additive to each other their resultant changes very slightly with considerable changes in their phase angle. This method of synchronizing is known as "synchronizing bright," since if lamps are used for the indicating device they will burn at maximum brilliancy when the electromotive forces are in phase. The practice known as "synchronizing dark" implies the comparison of electromotive forces which come into exact opposition when the machines to be synchronized come into phase with each other. It is evident in this case that, as the machines approach the proper phase relation for throwing together, the voltages are difficult to observe, either by phase lamps or by the ordinary alternating-current voltmeter, in which the scale is contracted in the region of low voltages. As distinguished from the ordinary methods of synchronizing above referred to, the in-



SYNCHRONISM INDICATOR.

ventor makes use of electromotive forces which are normally out of phase with each other when the machines to which they are due are in phase. The apparatus which has been found convenient to use consists of a dynamometer instrument having two relatively moving coils, one of which is connected across one phase of one of the machines and the other across another phase of the other machine. When the machines are in phase with each other, the movable part of the instrument will be subjected to a series of equal alternating impulses, which balance each other and cause no tendency to motion in either direction. Supposing, for example, the machines to be synchronized are of the quarter-phase type, when one is displaced ninety degrees in phase in one direction from the other the synchronizing instrument will have a maximum torque in one direction, while if the phase displacement is ninety degrees in the opposite direction the synchronizing instrument will have a maximum torque in the other direction. As the machines approach and recede from the relative position corresponding to synchronism, the movable member of the synchronizing device will swing back and forth over the scale, and by its position on the scale will indicate the changes in phase relation between the machines. When the pointer or other indicating device of the synchronizing instrument passes the zero or middle point of the scale, the machines to be synchronized are in phase with each other. Since at this time the needle is in the middle point of its swing, its velocity at this moment is a maximum, thereby giving accurate indication of the proper moment for throwing the machines together, and by its movement signifying sensitively any difference in speed between the machines.

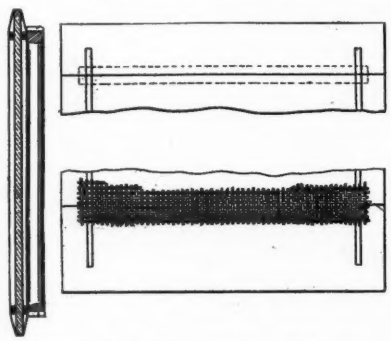
A trolley for electric railways that is guaranteed not to disengage the wire has



TROLLEY FOR ELECTRIC RAILWAYS.

been invented by a resident of Ottumwa, Iowa. Mr. Robert L. McCartney by name. The wheel is journaled in a bracket having on its outer sides beveled edges. A yoke surrounds the bracket and is pivoted thereto, the lower end of the yoke having a depending ear to which is attached the usual cord or cable. The upper ends of the arms of the yoke are inturned and are normally located above the wheel, over the wire, so that should the wheel and pole bound from the wire, the arms will engage the same and hold the trolley in proper position until reengagement takes place. The inner edges of the inturned ends of the arm are rounded, and small anti-friction rollers are, preferably, mounted thereon so that when the arms strike the hangers or their supports, they are spread thereby and will freely pass the same. When the trolley is to be removed from the wire, it is only necessary to draw downwardly upon the cord, as usual, whereupon the yoke will be swung upon the bracket and the arms, riding upon the beveled edges, will be spread apart so as to release the wire.

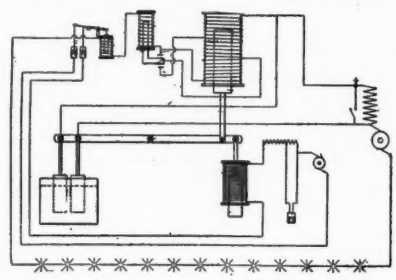
A secondary electrode for electrolytic apparatus and more especially of that type used in the manufacture of chlorates, has been patented by Professor and Doctor Paul Imhoff, a German chemist, residing in Liverpool. The United Alkali Company, Limited, also of Liverpool, has purchased the United States



SECONDARY ELECTRODE FOR ELECTROLYTIC APPARATUS.

patent. Several types of such secondary electrodes already exist, and among them are those in which the anode and cathode each consists of platinum sheet or wire and those in which the anode is formed of platinum sheet and the cathode is formed of some other metal, such as copper, the joint anode and cathode being separated or not by non-conducting or dielectric material except, of course, where the necessary electrical connection is made. According to this invention the manufacture of chlorate, for example, by electrolysis is effected with improved results and without the use of the expensive platinum electrodes, as heretofore, by employing an anode built up of platinum wires or strips and a cathode of a cheaper conducting material in the form of wires, rods, plates, bars, strips, or gauze, both anode and cathode being built upon opposite sides of a non-conducting supporting plate or body of slate, glass, stone, or other suitable material. The necessary connections between the anode and cathode are made by bringing the ends of the platinum wires or strips of the anode around the edges of or through the holes in the supporting plate or body and wrapping, welding, or otherwise fastening these ends to, in, or around adjacent portions of the cathode material.

Automatic regulators for increasing the strength of the field of a dynamo on an



AUTOMATIC REGULATORS FOR CONSTANT-CURRENT DYNAMOS.

increase of the external load and weakening the field strength on a decrease of the external load, so as to maintain the current constant, have hitherto been constructed and generally consist of a mechanism operated by an electromagnet or solenoid, the winding of which is in series with the main current. So long as the dynamo is working normally such regulators work more or less satisfactorily; but all series dynamos, and especially those of the open-coil type, are subject to flashing over, and when this occurs the current in the external circuit is reduced and the regulator immediately strengthens the field. Although the flash weakens the current in the circuit it greatly increases the current in the armature of the dynamo, and if the field is strengthened, as occurs with the ordinary regulators, the flashing over will continue and, indeed, be made worse. It thus becomes almost impossible for the machine to recover itself unaided. Mr. Felix B. O'Hanlon, of Portadown, Ireland, has patented in this country an improvement relating to this art. The invention consists in employing in conjunction with field-regulating devices of the ordinary type an additional electromagnet operating a mechanical or electrical relay device adapted to produce automatically weakening of the field of the generator when the current has fallen below a given value, and so give the generator a tendency to recover when flashing over occurs.

Reviews of Current Engineering and Scientific Literature.

Mineralized Carbons.

Carbons for arc lamps containing certain minerals have been used to some extent, but have some disadvantages. When a large amount of foreign matter is added to the carbon, an insulating gangue is formed little by little on the crater and this makes the arc unstable and finally ruptures it. To overcome this difficulty borates and other fluxes have been incorporated in the carbon paste, but these fluxes have a tendency to volatilize rapidly, and thus do not prevent the trouble. M. Hopelt has devised a method for preventing the interruption of the arc by the use of organic compounds of the metalloids, alkaline metals, or alkaline earths and heavy metals. These compositions are transformed into carbides in the arc, as the carbon burns away. To obtain these inorganic compounds, carbides are mixed with tar or other inorganic substance, and baked when polymerization takes place. Thus a mixture of calcium carbide and alcohol gives a composition Ca $(C_2H_5O)_2$, which decomposes and reforms the carbide in the temperature of the arc. Carbons made in this way are as compact and durable as the ordinary type. If these carbons can be made successfully, it is thought they will have considerable effect upon the use of flaming arcs, as this type of lamp has a high luminous efficiency.—*Translated and abstracted from l'Electricien (Paris), March 21.*

Water Power in South Africa.

This is an interesting illustrated discussion by Mr. Francis Fox, of the proposed development at Victoria Falls, on the Zambesi River, in South Africa. The author gives an historical sketch of the discovery of the falls, and describes the peculiar topography of the country at this point. After flowing over the falls, the stream passes through a narrow zig-zag gorge, which is supposed to be between ten and twenty miles in length. The total height of the fall is from 400 to 420 feet, that at Niagara being about 158 to 167 feet. The width of the Victoria Falls is one mile, and at times of flood the volume of water passing over is estimated as sufficient to develop 35,000,000 horse-power. At Niagara the river is about half a mile wide, and the average power running to waste is estimated at 7,000,000 horse-power. In the case of the Victoria Falls there are three islands, the centre one being known as Livingstone Island, as it was here that Dr. Livingstone planted a number of fruit trees. The mist arising from the falls is visible at low water from five or six miles distant, and it is said it can be seen ten miles off in times of flood. The appearance of this mist is peculiar, being white underneath and dark above, so that it resembles an enormous cloud of smoke. The Cape-to-Cairo road will cross the gorge just below the falls, on a steel arch bridge 500 feet in span and 400 feet above the water, and as soon as the road has been pushed to this point, it is proposed to begin the development of the falls. As this section of South Africa is rich in mineral deposits, an important manufacturing centre is expected to develop there. A suggested plan for developing the falls is to carry the water through eight-foot flumes down into the gorge below the second turn, and there discharge through turbines, resembling somewhat the plan for the Niagara Falls Hydraulic Power and Manufacturing Company, at Niagara Falls.—*Abstracted from Cassier's Magazine (New York), April.*

Parallel Operation of Alternators.

M. L. Drin here considers the methods of operating alternators in parallel to secure satisfactory results. An analytic study of the problem shows that for suitable operation the load should be divided uniformly among the various units, and this is secured by equalizing the potential of all the machines. To maintain a constant pressure on the circuit it is necessary to regulate all the machines, and this may be done by connecting together the regulating rheostats; or, if the armature reaction is not excessive, by adjusting them one at a time. For the distribution of the load three methods are considered—the methods of plural regulation, unit regulation, and central regulation. The method of plural regulation consists in fitting each prime mover with an independent governor, so that variations in the load on the system will be taken care of by all the generators. To operate successfully with this system it is necessary that all the regulators have the same sensibility. Unsatisfactory operation of any one unit may introduce serious trouble and cause surging, which is difficult to stop. A system which increases or decreases the load on all the machines simultaneously is evidently poor from the point of view of economy, and to avoid this some engineers have proposed the unit system of regulating. This consists of regulating the speed of the system by a single governor, acted upon by one engine. In this case the regulating machine must be large enough to take care of all variation in load on the system, and if these variations are great, the method may not be satisfactory. M. Rateau suggests a modification of this. He proposes adjusting the governors of all the engines for slightly different speeds. Then, during operation, variations in the load would be taken up by one machine until its full capacity is reached, when it will then fall back upon the next machine, and so on. The author suggests a slightly different arrangement from the above, which is to run all of the generators at something under full load, with one machine for taking up variations. When the latter reaches its full capacity it will then fall back upon the remaining generators. The system has been tried and gave satisfactory results. The central system of regulating is that where one governor, placed in the steam main, controls all the engines. So far no satisfactory mechanical governor has been found for this purpose, and it is suggested that possibly an electrical governor operating upon the wattmeter principle might give satisfactory results. The use of asynchronous motors as generators is then touched upon. In this system, one synchronous machine, called the "leader," fixes the frequency. The system is very simple, provided the power-factor is high, but when this falls as low as 0.9, the output of the synchronous machine must be equal to that of all the other machines together.—*Translated and abstracted from Revue Pratique de l'Electricite (Paris), March 20.*

Recent Applications of the Braun-Siemens & Halske System of Wireless Telegraphy.

In this article M. E. Guarini gives some data of recent applications of the Braun-Siemens & Halske system of wireless telegraphy in Germany. The developers of this system are at this time aiming more for accuracy and certainty than long distance. An interesting trial of this system was made at the time of the German military manœuvres. The battalion of aeronauts, to whom was en-

trusted the wireless telegraphy department, had been provided with two fixed and three movable stations, which answered perfectly the purposes for which wireless telegraphy is required in military tactics. The object was twofold—to establish reliable and permanent communication between the various detachments of an army, and to maintain this communication throughout the most rapid military operations, such as the march of a division of cavalry. The stations in this case worked accurately over a distance of 100 kilometres. The aerial wire was raised by small captive balloons or kites; but as this method did not give a sufficient range, the power at the sending stations was increased and a slight modification made in the sending circuit. The movable stations consist each of two vehicles, drawn by teams, one containing the sending apparatus and the other the receiving apparatus. The energy was supplied by a two and one-half kilowatt dynamo, driven by a gasoline engine at 800 revolutions, giving 120 volts. All apparatus was carried on these vehicles, hydrogen for inflating the balloons, etc. In this way constant communication was maintained between the commander-in-chief and the cavalry division when marching. It is stated that the Braun company is at present tuning its different stations, and has obtained favorable results in this direction. There has also been some talk of a combination of the two rival companies—the Braun and the Slaby—though no agreement has been reached as yet.—*Abstracted from the Electrical Review* (*London*), *March* 20.

The Action of Electrical Shock.

A report has been made by Dr. F. Batteli, of the University of Geneva, upon the precise nature of the effects which cause death from electric shock, and it would seem from this that currents of high tension cause death in a different manner to currents of low tension. Currents at a pressure of about 12,000 volts or more kill by inhibition of the nerve centres and arrested respiration. The heart continues to beat with energy, and is only arrested by asphyxia, causing great arterial pressure. In such cases the animal may, in general, be restored by artificial respiration. On the other hand, currents of low tension, not exceeding 120 volts, and passing from the head to the feet, kill by producing paralysis of the heart, and the animal continues to breathe for some time after becoming unconscious. These low-tension currents apparently stop the heart by causing irregular contractions, thus disturbing its rhythm. Doctor Battelli and Professor Prevost have made the discovery that high-tension currents are capable of restoring the action of a heart that has been arrested by a low-tension current; but as the application to be successful, must be made not more than fifteen or twenty seconds after the arrest of the heart's action, it is hardly likely to prove valuable as a practical restorative. The path traversed by the current in passing through the body is a matter of great importance. The most dangerous is from one hand to the other, because the resistance of this path is low, and because the current passes near the heart. Hence, it is a good rule for workmen and others handling live conductors to use but one hand. An important rule to observe in rescuing a person in contact with a live wire, and when it is impossible to cut off the current, is to push the victim off with one foot. Even should current pass from one foot to the other through the rescuer, the resistance of the path is considerable, and as the current does not pass near the heart, serious injury is not likely to result.—*Abstracted from the Mechanical Engineer* (*London*), *March* 21.

Notes on the Series Running of Arc Lamps by Rectified Currents.

In this article Mr. W. Rogers discusses the advantages of rectified currents over alternating currents for running arc lamps, and describes the performance of the Ferranti constant-current transformer. The luminous efficiency of the continuous-current arc is greater than that of an arc with an alternating current, since in the latter case no crater is formed, and about half of the light is thrown upward and not downward, and is therefore lost. When high-tension alternating currents are used for distributing power for arc lamps, to secure the high efficiency arc it becomes necessary to employ either a motor-generator set or a rectifier. An installation using rectifiers was made in Portsmouth eight years ago, and has been working satisfactorily since that time. The rectifiers are used in connection with a constant-current transformer, which reduces the pressure to that proper for the arc light circuits, and at the same time maintains the current constant. The transformer consists of a fixed primary coil, with its axis in a horizontal position, and two movable secondary coils which automatically approach and recede from the primary as the load on the circuit varies. From the transformer the current passes to the rectifier. This is a small synchronous motor with four stationary armature coils and a revolving field. The revolving field is fed by a rectified current at a difference of potential of but a few volts, this pressure being obtained by taking tappings from a coil in the armature. In starting the motor, the fields are first put in parallel with the armature through a resistance, and are changed over to the low-voltage tapping when synchronism is obtained. The speed of the motor is about 1,500 revolutions per minute, with an output of one-half horse-power. The high-tension commutator consists of three spider-shaped castings, with hard-drawn copper segments riveted to them to take the wear on the brushes. When the motor is running at synchronous speed, the circuit is broken in two places on each pole near the zero line of the alternating-current curve. These rectifiers may be used on any circuit having frequencies between 40 and 100 cycles per second. Comparing the cost of rectifiers with other systems, it is said that the initial outlay in station plant required for a rectifying system is only one-quarter of that for a direct-driven, continuous-current set of the same output, while the floor space is about half. As regards consumption of carbons, it has been found that the cost of carbons used on a rectified circuit was just half as much per annum as on an alternating-current system. Tests of these machines have shown an efficiency of ninety-one per cent, with a power-factor of 0.9.—*Abstracted from the Electrical Engineer* (*London*), *March* 20.

A New Circuit Controller.

Mr. S. Z. de Ferranti has invented a new device for controlling circuits, in which he utilizes a property of an electrolytic cell as a protection against excessive rise of voltage. Certain metals, such as aluminum and chromium, when used as anodes, form a coating which greatly increases the internal resistance of the cell, so that it will stand a potential approaching 100 volts without breaking down, although passing a small current. If a certain critical voltage be exceeded, the resistance of the cell breaks down, allowing a much larger current to pass through. If the potential be then

lowered the current is again choked back, owing to the coating which has been formed reasserting its high resistance. The invention is applicable to both continuous and alternating currents, although in the latter case both electrodes must be of the particular metal used. The electrolyte may be a solution of bichromate of potash, sodium phosphate, or a soap solution. The device may be used in conjunction with an automatic switch, to prevent this from being opened until the current has been reduced to a small value. The cells are placed in shunt with the switch, and as many as may be necessary connected in series, depending upon the voltages of the circuit. In another arrangement the cells are arranged in series, and cut out or cut in one at a time, thus reducing the current or allowing it to increase slowly. A third arrangement is used in connection with high-voltage oil-break switches. The electrodes are disc-shaped, and are arranged one above the other, somewhat like the old galvanic pile. Leads are run from certain points to terminals within the switch cylinder, and contact is made with these terminals, one after the other, as the plunge switch descends to its sockets when the cells are short-circuited. The device may also be used as a lightning arrester, a sufficient number of couples being connected in series to prevent the normal voltage of the circuit from passing a large current through them. When the lines are struck, the cells will permit current to flow until the discharge has taken place, when the initial resistance of the cell will be reestablished, stopping the current. A number of other applications of this device are described, in which it acts to prevent too high a potential being established between any two points.—*Abstracted from the Electrician (London), March 20.*

The Use of a Rotating Cathode in the Electrolytic Determination of Metals.

This is a contribution from the Kent Chemical Laboratory, of Yale University, by Messrs. F. A. Gooch and H. E. Medway. The rotating cathode has been applied in the arts for the purpose of securing compact metallic deposits in electroplating. In this case a soluble anode is employed, and the electromotive force used is low. It was thought that this method might be modified for electrolytic determination of metals, allowing an increased rate of deposit, and thus shortening the time without impairing the accuracy of the result. In electrolytic determinations a soluble anode is not used, and the comparatively high electromotive force necessary to overcome the resistance and throw down the metal with rapidity liberates oxygen from the water solution simultaneously with the metal, and the consequence is the production of a deposit lacking in compactness and adhesiveness. This interference on the part of the evolved hydrogen seems to be the chief reason why low currents must be used in the ordinary electrolytic processes of analysis. The apparatus experimented with consisted of a glass beaker and a platinum anode, which could be revolved. For the cathode, a platinum crucible was used. Into this was slipped a rubber stopper, which was then slipped over the end of the vertical revolving shaft. Electrical connection was made between the shaft and the crucible by means of a thin platinum strip. The vertical shaft was made in two parts for convenience, coupled together by a piece of stiff rubber tubing. A small motor was fixed with its shaft in a vertical position for revolving the cathode. About fifty cubic centimetres of solution were experimented with, slightly acidulated to give better conductivity. The crucible was adjusted in the solution to give a cathode surface of about thirty square centimetres. Tables are given showing the results with various solutions of copper, silver and nickel. The motor was run at a speed of from 600 to 800 revolutions per minute. With a solution containing six and one-half centigrammes of copper, and a current of one ampere, the copper could be deposited in ten minutes, with an error of from 0.2 to 0.3 of a milligramme. With a solution containing about 0.25 of a gramme of copper and a current of four amperes, the copper could be deposited in fifteen minutes, with an error of from 0.2 to 0.3 of a milligramme. The results obtained with silver and nickel were as satisfactory, the deposit in each case being sufficiently adherent and compact to permit accurate manipulation and weighing, even when the current density on the cathode was very considerable and variable within wide limits. The advantages of this rotating cathode are—the process is rapid, exact and simple, and the apparatus is inexpensive.—*Abstracted from the American Journal of Science (New Haven), April.*

The Auckland Electric Tramways, New Zealand.

This article gives a very detailed description of what is probably the most important electric tramway in the British colonies. Auckland is one of the most flourishing towns in New Zealand, and is built upon an extremely hilly site. The tramway consists of about twenty-nine miles of single track, stretching right across the island. The population served is about 70,000. Under the laws of New Zealand, no private promoter can apply direct for tramway powers, so that it was necessary for the Auckland city council to obtain the necessary powers, which were then delegated to the Auckland City Tramways Company. The existing horse tramways were taken over, and the conversion into electric traction begun in July, 1901. The track construction consists of a ninety-two-pound grooved rail, bedded about one inch in longitudinal concrete sleepers eighteen inches wide by nine inches deep, tie rods being used. The roadway between the sleepers is filled with macadam. A standard length of rail of thirty-seven feet was adopted. The wide streets enabled centre pole construction to be used. The trolley wire is No. 00 B. & S. gauge, flexible suspension being used throughout. Within the central quarter of the city the feeders are of No. 40 B. & S. gauge, laid in tile conduits constructed on the Camp system. Through the outlying districts, feeders, telephone and test wires are carried on brackets fastened to the top of the pole. The power station contains four Babcock & Wilcox boilers, a Green economizer, and three Corliss engines of an indicated horse-power of 475 each. These are directly connected to three 300-kilowatt, eight-pole railway generators, constructed by the General Electric Company, Schenectady, N. Y. Three boosters, each consisting of a shunt-wound motor direct-coupled to a series-wound generator with a capacity of 125 volts at 330 amperes, and one booster with a capacity of 20 volts at 400 amperes, were furnished by the same company. Condensing water is drawn from the harbor. Telephone stations are placed along the line, and each car is furnished with a telephone instrument and an attachment for plugging into these telephone boxes. The standard size of motor adopted was forty brake horse-power. Two of these are used on single-deck cars, and four upon double-deck cars. The first section of the road was opened last November, and this carried, in the first thirteen and one-half weeks, about 2,234,000 passengers.—*Abstracted from the Tramway and Railway World (London), March 12.*

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Open-Type Storage Batteries.

The Columbus Storage Battery Company, Cleveland, Ohio, has placed on the market an open-type battery which, it is claimed, posesses many features of merit, both in design and construction. The lead grids used have several distinctive features. These are cast by an improved and rapid process, from pure lead, no alloys of any description being used. In order to give them rigidity a narrow rib runs vertically on each side of the plates; and one, two or more ribs—depending on the size of the plates—run vertically throughout the centre of the plates. This may be seen by reference to Fig. 1 of the accompanying illustrations. This construction ensures a straight plate throughout the life of the cell, and obviates any trouble due to buckling. The horizontal lead leaves are thin and closely spaced, so as to give a large contact surface between the metallic lead and the active material, and, at the same time, hold the active material securely in place.

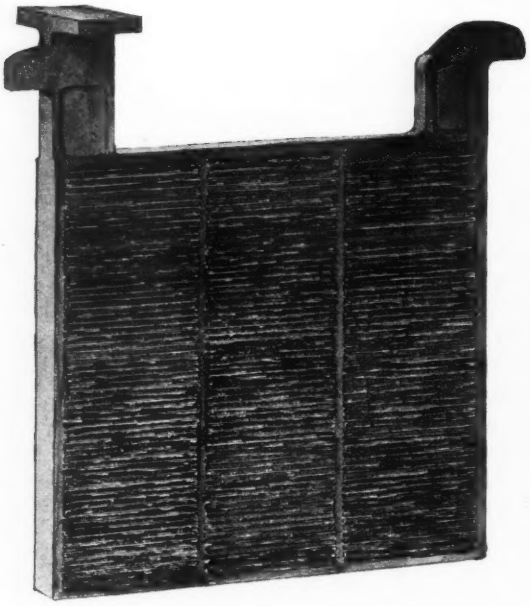


FIG. 1.—FORMED LEAD GRID.

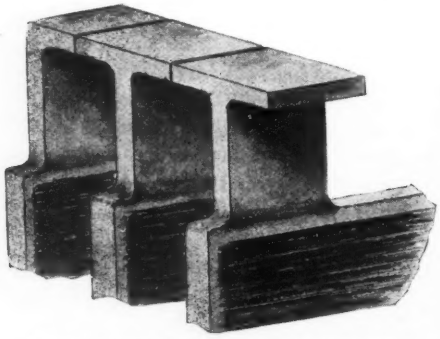


FIG. 2.—LUGS FOR PLATE TO PLATE CONNECTION.

After the plates have been filled, these leaves are bent over slightly toward the upper part of the plate, thus making it almost impossible for the active material to be removed from the plates after they have been put through a special hardening process.

In all of the smaller types the lug on the end of the plate is cast into the shape of a T. This is shown at Fig. 2. This lug is generously proportioned so as to ensure long life and to withstand any destructive action which might take place just above the surface of the electrolyte. The construction of this T-head permits of a perfect joint being made, the two clean, even surfaces being brought together, a mould placed around the end part of the joint, and an oxyhydrogen flame applied at the top. This melts the lead clear through, which upon cooling produces a smooth joint.

The connecting strap is cast with the plate, and is an integral part of it, so that in a five-plate cell, for example, there are but three joints. Lead-covered connecting bolts are furnished for joining open-type cells and for joining sealed cells.

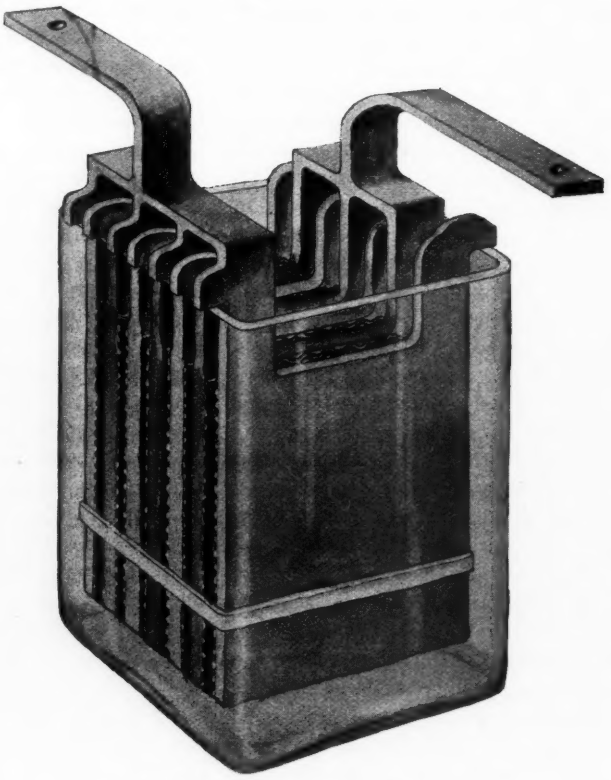


FIG. 3.—COMPLETELY ASSEMBLED BATTERY.

Hard rubber sheet separators are used in all but the very largest open-type cells, and are used exclusively in all sealed cells made by this company. The general construction and appearance of a complete Columbus storage battery cell is shown in Fig. 3. Each strap is always cast as an integral part of one of the plates, and is usually inserted in the middle, so that it can be bent over in either direction, avoiding trouble and confusion due to rights and lefts. In open-type cells having a capacity of over 320 ampere-hours, glass rod separators are used.

A portable sealed cell is also manufactured by this company. The distinctive feature of this apparatus is the facility with which it is entirely disassembled. To take the cells apart, the four lead-covered nuts on the ends of two bands which pass around the jar are unscrewed. The metal rim is lifted off, and then the elements are removed, leaving the under lid in place around the terminals of the

elements. A soft rubber gasket is interposed between the edge of the glass receptacle and the internal lid. In this way the cell can be easily taken apart and cleaned, so that it may have as high an efficiency as possible under service conditions. This company also manufactures portable storage battery cells in hard rubber jars, for automobile and other work of this description.

Fan Motor Apparatus.

The Peerless desk fan motor, manufactured by the Peerless Electric Company, of Warren, Ohio, is of the usual enclosed form, provided with self-oiling bearings and automatic feed brush-holders. The field magnet is cast of a special grade of imported metal, selected after a series of tests made with material submitted by over a dozen of the leading foundry men of the country. The magnet poles are integral with the yoke ring, and are of large cross-section. They are all of the bipolar type, with the field windings connected in series with the armature. The coils are form-wound and insulated with the best grade of linen tape and then treated with a peculiar insulating compound used in all Peerless motors. The low-voltage, direct-current armatures are wound with double cotton covered magnet wire, and the high-voltage armatures are wound with double silk covered wire.

The coils are insulated from the armature by oiled linen and after the winding is in place and connected to the commutator it is tested for breakdown between the coils themselves and between coils and core, with 500 volts for 110-volt and 220-volt armatures, and 1,000 volts for 250-volt and 500-volt armatures.

The armature is of the usual slotted-core, drum-wound type. The brushes are of the carbon pencil type, and the brush-holders are of the cartridge type, thoroughly insulated from the frame of the machine by heavy fibre tubes extending over half the length of the brush tube. The commutator of every type of Peerless fan, both ceiling and desk, is built up of the best grade of hard-drawn Lake Superior copper bars, machined to shape and insulated with India mica; the same grade of mica is used to insulate the ends of the segments from the clamping rings, which are of the same class of construction as those in commutators on standard makes of power motors, being accurately machined to gauge by special tools.

The 110-volt and 220-volt motors have speed regulating rheostats, the resistance coils of which are of German silver wire, of ample cross-section to prevent overheating, wound on porcelain spools, with the various layers separated by sheet asbestos. All parts are insulated after completion with an insulating compound guaranteed to stand a temperature of 500 degrees. The various switch contacts and main terminals are mounted on a porcelain disc, as usual in this class of machine. The desk fans have three speeds.

The Peerless Electric Company has also brought out an alternating-current induction fan motor which has some new features worthy of note. The starting switch, which is located in the back of the casing, is so constructed that the movement of turning the current on also imparts an impetus to the rotor and fan, the machine not being of the self-starting type. The rotor is of the squirrel-cage pattern, with a shaft of drawn steel. The bearing of the shaft is long and is composed of a seamless drawn tube of phosphor-bronze forced into position in the fan motor case, being reamed to accurate size after it is placed in position, thereby avoiding the liability of a poor fit on the motor shaft. The base of the starting device and switch is made of vulcanized rubber, and the contact blades and points are of phosphor-bronze. The mounting is of the swivel and trunnion type. The motors are made with three speeds and are of two sizes—12-inch and 16-inch. They are wound for any voltage and frequency up to 250 volts and 140 cycles.

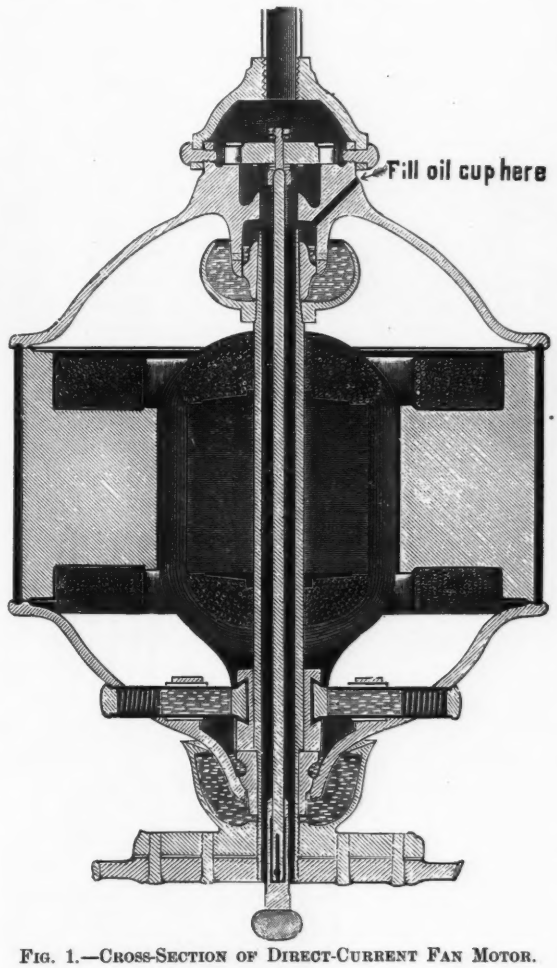


FIG. 1.—CROSS-SECTION OF DIRECT-CURRENT FAN MOTOR.

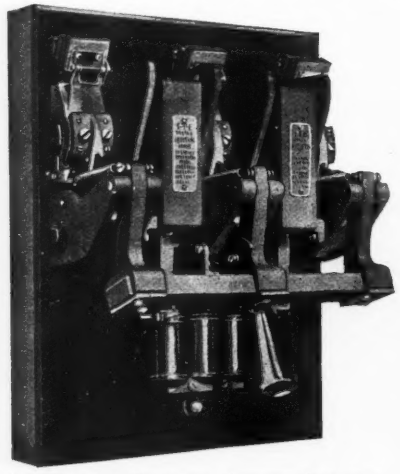
The Peerless type "H-2" ceiling fan is built for all of the usual direct-current voltages, and Fig. 1 is a cross-section of this machine. The motor is bipolar, with form-wound coils throughout, and the insulation and other features are the same as in the desk motor. The lubrication of the bearings is effected by means of two oil baths in which the bearings are submerged. The switch spindle passes up through a hollow armature shaft to the switch at the top of the machine. The bearings are of high-grade gun metal and the bushings are self-aligning. The brushes and brush-holders are of the carbon pencil and cartridge type, which is now so universally used, and are accessible without removing any of the casing. The sweep of the blades is sixty inches, and the normal speed with four blades is 200 revolutions per minute, with two blades the speed is increased to 220 revolutions per minute. The power consumption ranges from 110 to 115 watts, according to the voltage. The 500-volt fans run at one speed only, but those for lower voltages are provided with a two-speed rheostat in conjunction with the switch. The Peerless company has also brought out this season a standard ceiling fan, finished in black japan, similar in all other respects to the type "H" fans, save that it is made without switch. An attractive column fan is another addition to the Peerless line.

The Western Electrical Supply Company is the western distributor for this apparatus.

There are two varieties of mica having a commercial importance—muscovite and phlogophite. The former is that most commonly seen, and is a constituent of many crystalline and sedimentary rocks. Its principal value is due to its occurrence in blocks or masses (called books) capable of being split into sheets a square inch or more in size, the value of which increases with increasing size.

I-T-E Alternating-Current Circuit-Breakers with "No Voltage" Release.

The use of the auto-converter or other hand-operated device for starting polyphase motors, introduces a condition requiring the employment of suitable protective apparatus, for when a motor is running and the starting switch is in the running position (with the independent coil cut off), if the switch in the power-house is open, the motor will come to rest. Should the switch then be closed,



ALTERNATING-CURRENT CIRCUIT-BREAKER

the motor will be short-circuited on the line, and where a number of motors are thus brought into circuit, the resulting overloads may seriously affect the generator.

The Cutter Company's new alternating-current circuit-breaker with the "no voltage" release very effectively meets these conditions. It consists of a spring-actuated switch, which is normally held closed by a latch, which in turn is under the control of the armature of the "no voltage" magnet. This magnet is wound with high-resistance coils, one across each phase, and only when all are properly excited will the armature be held in position upon the pole-pieces of the magnet. Failure of voltage in any one or all of the phases causes the release of the armature and the consequent opening of the circuit-breaker.

I-T-E alternating-current circuit-breakers may be supplied with "no voltage" actuation alone or with this feature in connection with the usual overload operation. In the latter case fuses are unnecessary, while the plain "no voltage" circuit-breaker furnishes an indispensable adjunct where fuses are used.

I-T-E circuit-breakers are now built by the Cutter Company, of Philadelphia, Pa., in a wide variety of types and capacities, adapting them to all classes of polyphase service at voltages of 2,200 or less.

Large Transformers and Special Transformers.

The accompanying illustrations show some of the forms of large transformers and special transformer apparatus made by the Stanley Electric Manufacturing Company, Pittsfield, Mass. Fig. 1 shows a 700-kilowatt transformer, assembled complete. The windings of this transformer, both primary and secondary, are subdivided into from four to eight separate coils, each coil being wound in a number of layers, thus permitting the voltage between the layers and across the terminals of any one coil to be kept low, and to allow each individual coil to be thoroughly insulated, both internally and externally, before it is surrounded by the iron core. In the smaller transformers the coils are placed on both legs of the iron, and in this case the design is known as the "core" type. Those wound for 30,000 volts and of 200 kilowatts capacity and larger have iron built up on both legs of the coil, forming a complete shell around the coil, from which the design is called the "shell" type. This style of construction is shown in Figs. 2

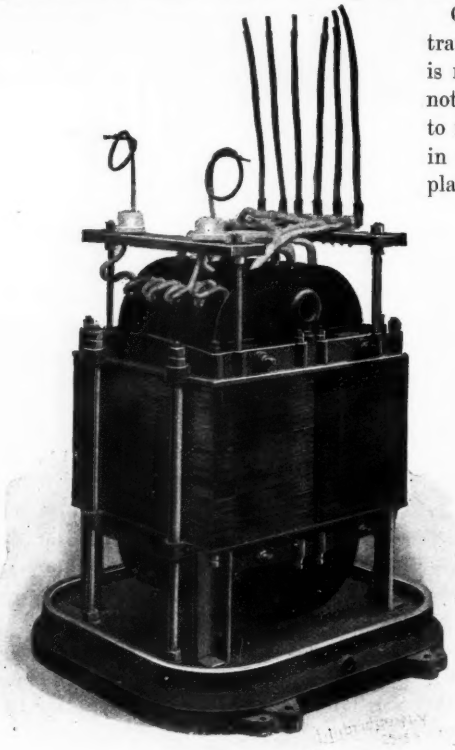


FIG. 2. 500-KILOWATT TRANSFORMER COIL AND CORE BUILT UP.

and 3. In both designs the coils are placed side by side, a secondary coil between any two primary coils, and are insulated from each other and from the iron by sheets of insulating material, liberal space being left so that the oil can circulate freely

FIG. 1.—700-KILOWATT TRANSFORMER ASSEMBLED COMPLETE.

around the various coils and between the coils and iron.

One of the important details of these transformers is that the encasing shell is made of heavy boiler plate, which can not be broken or torn or punctured so as to release the oil and allow it to flow out in case of accident or fire. The boiler plate is riveted to the cast-iron base and then thoroughly caulked. The mass of coils and iron is also rigidly fastened to this base, and is not in any way supported by the cast-iron shell, the style of construction being that shown in Fig. 3. Heavy eye-bolts with turn buckles pass through the base and cover, making a most secure and substantial combination, and one in which strains due to shipping and lifting will not cause leaks.

The spiral coil, through which the cooling water passes, is made of brass. This is preferable to iron, due to its non-corrosive properties; and, being of a thinner gauge and of higher conductivity than iron, it conducts the heat with greater facility, dissipating a given heat with a consumption of less water.

Thermometers of centigrade scale are furnished on all transformers of 100 kilowatts or greater capacity. The thermometer extends through the case, so as to be surrounded by the oil, and indicates

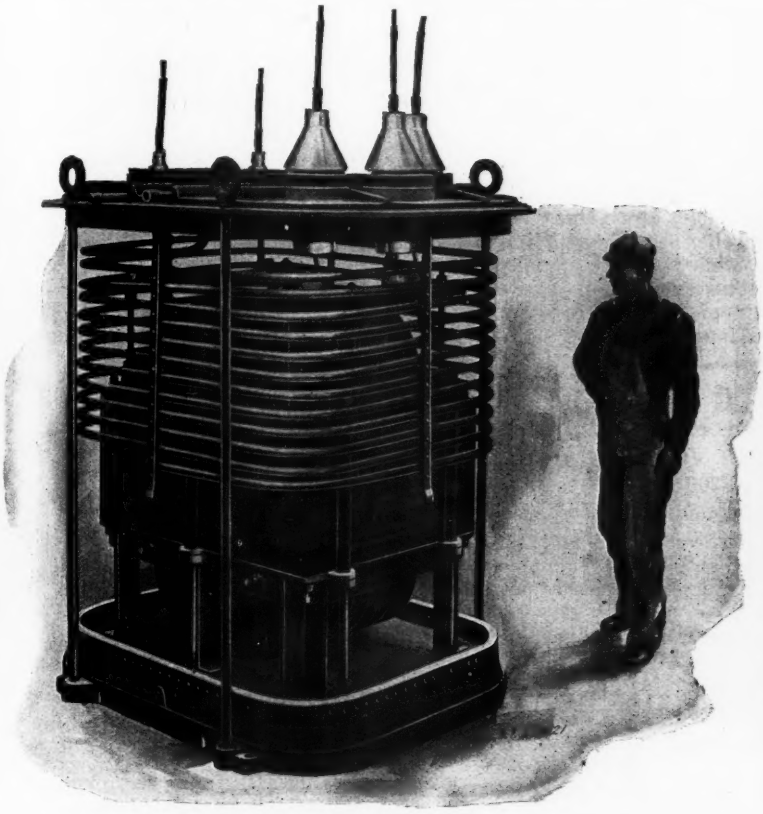


FIG. 3.—800-KILOWATT TRANSFORMER WITHOUT CASING.

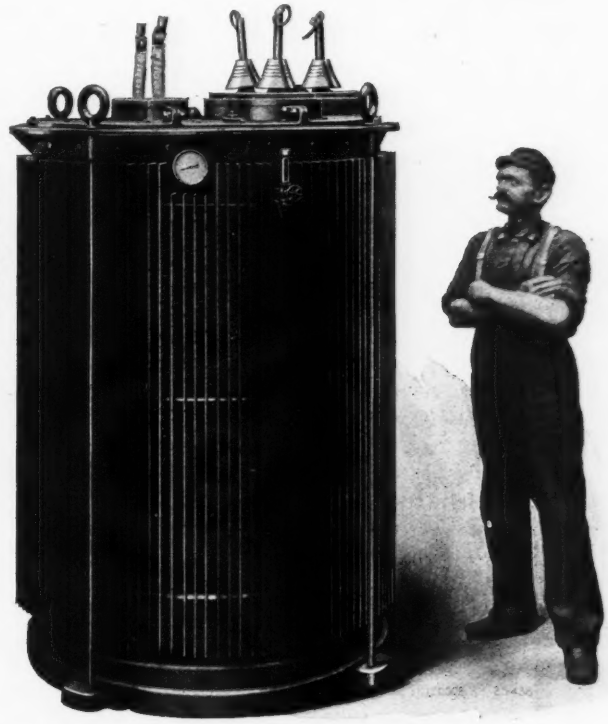


FIG. 4.—110-KILOWATT SELF-COOLED TRANSFORMER.

to the attendant whether a greater or less flow of water is desirable.

Fig. 4 shows a 110-kilowatt, oil-insulated, self-cooled transformer. The general description of the water-cooled transformers applies to this type of transformer, with the exception that it depends exclusively upon a large radiating surface and the natural circulation of the insulating oil for the dissipation of the heat caused by the transformer losses. The illustration will show the large radiating and convective surface, which is provided by strips of iron fastened around the outer surface of the tank or case. These transformers are wound for voltages up to 35,000 volts, and are made of from 10 to 500 kilowatts capacity. These are intended for continuous heavy duty, and are suitable for use in all places where water for any reason is not available for cooling purposes.

A transformer regulator head is also made for use with transformers having taps brought out from either the primary or secondary windings, so that the voltage may be raised or lowered a certain per cent above or below normal voltage by cutting in or out portions of the windings. The design and construction of a transformer with regulating taps is practically similar to that of the ordinary transformer where the windings are subdivided and placed on the iron, with the exception that an extra winding, corresponding to the desired percentage of regulation above normal voltage, is wound over the main coils. This extra coil is

FIG. 5. SUBWAY TRANSFORMER.

thoroughly insulated from the main coil, and has no connection with the latter except through the regulator head, which is generally placed on the switchboard. From these regulating windings taps are brought up to the terminal board, and thus out through the cover to the regulator head, the number of taps brought out being governed by the total number of steps into which the desired regulation is to be divided.

Fig. 6 illustrates a line of transformers particularly designed for installation in subway manholes. These are built regularly of five to forty kilowatts capacity, but the external diameter of all sizes is twenty-four inches, so as to pass easily through the opening of the standard manholes, the length increasing with the capacity. These are of the oil-insulated self-cooling type, and can be built for any periodicity or wound for any pressure not to exceed 2,400 volts on primary or secondary. The primary and secondary terminals consist of a gland or tube of metal passing through a water and oil-tight joint in the iron case. A lead covered cable can be passed through this tube and attached to the coil terminals inside the case, and a wiped lead joint made, connecting the exterior projecting gland and the cable. A plug is provided near the bottom of the case for drawing off the oil when necessary.

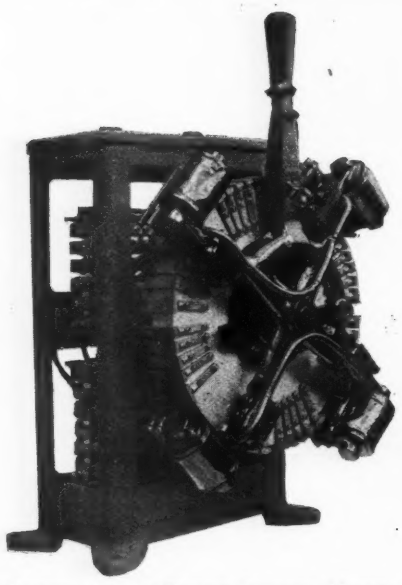
With an inch nozzle it would take 125 feet head of water to throw a stream of water 100 feet high. Under such pressure about 200 gallons per minute would be discharged.

Regulating and Reversing Controller for Direct-Current Motors.

For the control of direct-current motors operating cranes, hoists, etc., and similar appliances requiring variations in speed and frequent stops and reversals, the Westinghouse Electric and Manufacturing Company has placed upon the market an improved controller of the commutator type which has been designed especially for this class of work.

This controller is similar to the well-known Westinghouse commutator type controller which has been in general use for some years, but embodies several changes and improvements.

The necessary resistance is mounted in-



CONTROLLER FOR DIRECT-CURRENT MOTORS.

side of a cast-iron frame, on the outside of which is attached the commutator, or contact dial, for regulating the amount of resistance in circuit and for reversing the motor.

In the smaller sizes the resistance is of the ventilated cell type as shown above. This construction is the same as that used in the Westinghouse standard railway controller resistance, a service where its efficiency and durability have been proven by years of the hardest usage. The resistance in the larger sizes consists of cast-iron grids of very durable construction. These grids are capable of withstanding very severe use, it being practically impossible to burn out or otherwise injure them. They are also the same as those used in railway service.

The contact dial is made up of copper contacts which are fastened to the periphery of a circular stone of good mechanical strength and toughness, affording a firm support and giving excellent insulation for the parts. The contacts are simple and so made that they may be easily renewed when injured by wear or any possible arcing. Their total makes possible a correspondingly large number of steps of resistance, giving a very gradual regulation to the motor.

The brush-holder is fitted with four contact arms, which, when the circuit is opened, divide the arc into four breaks. Each contact arm is provided with a powerful blow-out magnet which reduces the arcing to a minimum and makes the maintenance of an arc impossible.

The whole construction has been made as compact as possible, care being used to make this controller peculiarly applicable to crane use, while it answers equally well for the operation of elevators, hoists, and other classes of work where series motors are used intermittently.

Cable Clips.

The "H-P" cable clip, which is manufactured by Messrs. James S. Barron & Company, of 200-206 West Broadway, New York, is made of one piece of zinc, and is therefore rustless and has no parts to become detached and lost. At the same time it is a simple device and easily put on.

To apply the hanger, the circular enlargement is held against the cable with

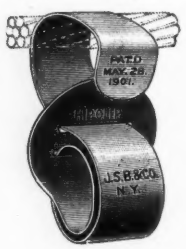


FIG. 1.

FIG. 2.

the left hand, while the free end is wound around and passed through the slot as shown in Fig. 1. It is then wound around

FIG. 3.—APPROXIMATELY FULL SIZE OF CABLE HANGER.

again, put through the upper slot and carried over the suspension wire, after which it is bent and hooked into the upper slot, as shown in Fig. 2 of illustrations herewith.

These illustrations are approximately half size. The largest engraving (Fig. 3), showing hanger gripping the cable, is approximately full size of a ten and one-half inch hanger. These hangers are made in all lengths from ten and one-half inches up; the widths being the same in all lengths.

The manufacturer reports having received orders for over 200,000 within the past year.

Electric Motors in a Cement-Making Establishment.

The complete electrical equipment of the Alsen's American Portland Cement Works gives a very recent evidence of the adaptability of the use of motors for working under the peculiar conditions which obtain in such a plant. The Alsen's works is situated at Alsen, a few miles below the village of Catskill, on the west of the Hudson River, New York. In this establishment, the raw stone is quarried by electrically operated drills, and the rock located on a tramway running on tracks on a trestle passing over the West Shore Railroad. The quarry is inside of a cliff and the loaded car runs on a slight grade to the third story of the raw material building. The track is doubled with a loop at each end, and the cars are drawn by an endless rope driven by an electric motor. An inclined belt conveyor raises the clay from the ground outside to the raw material building. The raw stone is dumped from the cars upon the floor and then dropped in hoppers supplying to crushers, each belted to an electric motor. From the crushers, broken stone falls into rotary driers, from which there are two, each forty feet in diameter and forty feet long. From the driers a bucket elevator raises the stone to spouts discharging into bins over the ball mills, of which there are four in this department. From these mills, suitable conveyors and an elevator finally distribute the rock in the stone bins, of which there are six. All of the apparatus for manipulating the constituents of the cement from the quarry, the raw material to the completed product, is operated by electric motors.

There are nine rotary kilns, each six feet in diameter and sixty feet long. From the drier the clinker falls into storage pits of which there is a double row beneath the lower ends of the kilns. The two rows are divided by a tunnel in which trolley cars are run, the clinker storage pits having copper bottoms so that the clinker can be chuted into the cars by open sliding doors. The clinker is cooled by a blast of air that is forced

up through it by two blowers, delivering air into a duct carried along under the roof of the tunnel, and having branches supplying air to each clinker pit. One of these blowers is shown with a direct-connected motor in Fig. 1.

FIG. 1.—DIRECT-CONNECTED MOTOR AND BLOWER FOR FURNISHING AIR TO CLINKER PIT.

There are four tube mills, and their output is conveyed to an elevator to tanks over the four tube mills that accomplish the final reduction. There are four ball mills and four tube mills in each department, all directly connected to electric motors. Fig. 2 shows a general view of the ball and tube mills.

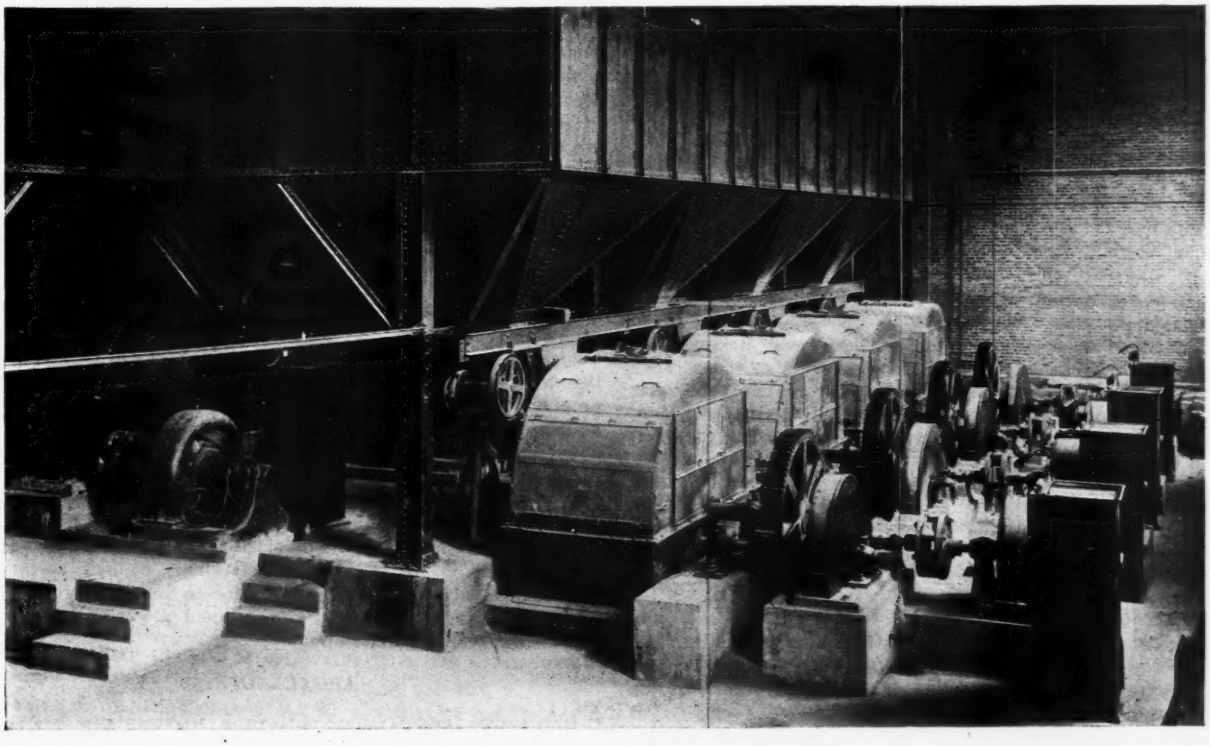


FIG. 2.—GENERAL VIEW OF BALL AND TUBE MILLS.

Another interesting application of the motor is in the direct driving of the dust collector in the finished material department. This is one of the most difficult situations for which a motor can be used, as the prevalence of dust makes the conditions extraordinary. This is shown in Fig. 3.

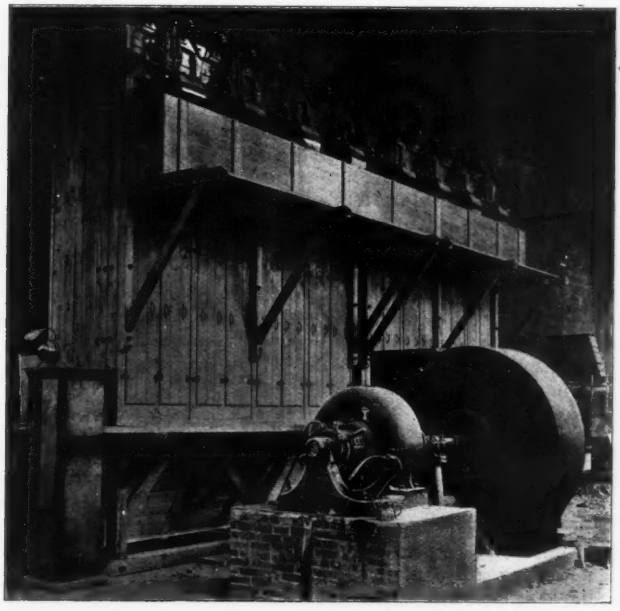


FIG. 3.—DUST COLLECTOR IN THE FINISHED MATERIAL DEPARTMENT.

The Crocker-Wheeler Company, Ampere, N. J., supplied the generators and motor equipment. The motors, varying from five to seventy-five horse-power, amount to some forty-eight. The engine room is equipped with four generating units of 300 to 400 kilowatts capacity and one of 100 kilowatts.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

WIRELESS TRAIN SIGNALING TESTS—It is announced that the trials in Germany to establish wireless telegraphic connection between moving trains and stations by the Braun system have been successful on the military railway near Berlin. Telegrams were sent from the trains to the stations and *vice versa* without any difficulty.

JAPANESE ELECTRIC STREET RAILWAY—A British syndicate is negotiating for the purchase of the Tokio Street Railway Company. The original capital of the concern was about $400,000, but it is now proposed to greatly increase the field of operations and to raise the capital to $3,000,000. Sir Malcolm MacEacharn, of McIlwraith, MacEacharn & Company, London and Melbourne, is conducting negotiations on behalf of the British syndicate. He is now in Japan.

TROLLEY 200 MILES LONG—With the beginning of the construction at Morgantown, W. Va., of the new Morgantown electric railway, a start was made on what will be one of the longest electric railway systems in the United States—a line between Central West Virginia and Pittsburg. The Morgantown street-car line will be a link in the system that will extend from Buckhannon, W. Va., a town high up in the mountains of Upshur County, through the valleys to the industrial centre of Western Pennsylvania. The road will be upward of 200 miles long and a considerable part of it has been already completed, or is in an advanced stage of construction. The aggregate capital of the roads is over $100,000,000.

NEW INTERBOROUGH ELECTRIC SYSTEM—A franchise has been granted to the New York City Interborough Railway Company, giving the right to build thirty-six miles of railroad in the Bronx and thus permitting a second railroad to cross Macomb's Dam Bridge. The company has only $40,000 paid-up capital. The company has five years in which to begin work and the franchise is to last for twenty-five years. Wheeler, Cortis & Haight are counsel for the company. According to the franchise granted the Interborough company must pay into the treasury of the city of New York three per cent of its earnings, or at least $15,000, for a certain number of years, and after that five per cent, or at least $30,000.

NEW LIGHTING COMPANY FORMED—The Economic Lighting Company has been organized and has secured a charter to operate in Norfolk, Va. The officers are stated to be as follows: Samuel B. Lawrence, president; Alfred T. Davison, vice-president; Henry C. Everdell, secretary, and John B. Summerfield, treasurer. The company is authorized to issue $20,000,000 of capital stock. Samuel B. Lawrence is president of the Westchester Racing Association. John B. Summerfield is a director of the Gas and Electric Company, of Bergen County, N. J., and of the Spring Valley Gas and Electric Company, and a trustee of the City Savings Bank of Brooklyn. The company will begin business with an actual capital of $1,000,000.

MORE WATER POWER PLANTS—It is announced in Washington that Messrs. Stone & Webster, of Boston, Mass., the capitalists, who own the Interurban Railway, and the street railways of Tacoma and Seattle, have decided to make an expenditure of $4,000,000 in developing power on White and Puyallup rivers, for the purpose of furnishing electricity for their various lines, and also to furnish power for manufacturing plants in both cities. The White River plant will be located between Buckley and Muckleshoot Indian reservation, about twelve miles from Kent; the Puyallup River plant will be located opposite Lake Kipiusen twenty-six or twenty-seven miles from Kent. These two plants will develop about 20,000 horse-power.

ELECTRICAL POWER DISTRIBUTION IN GREAT BRITAIN—The use of electricity in every-day affairs is developing enormously in Great Britain. Parliament offers every encouragement by granting readily large powers to responsible companies. The first of the power bills was introduced in 1898, but the opposition was so strong and the favorable sentiment so little developed, that it was not until 1901 that grants were made under which the present companies are generally organized. There are now organized fifteen power companies. Some of these have done no work as yet, several are nearly ready to operate, and one, the Newcastle-on-Tyne Electric Supply Company, is fully at work. These companies are well distributed over England, with one company in Ireland and one in Scotland. The territory which will be fed when all are in active operation, will embrace about 10,000 square miles. The aggregate capital is about $65,000,000. One of the most important of these is the Derbyshire & Nottinghamshire Electric Power Company, which covers an area of over 1,500 square miles. Within this territory, there are 564 works of importance. About 400 firms, representing a capital of $100,000,000, supported the bill before Parliament. Six power stations will be erected after the same general plans. The size of the units will be 3,000 horse-power each. Power will be distributed as three-phase alternating current at 10,000 volts, the cables being laid underground. It is thought that this system will begin supplying current within three months. Other companies are also nearly ready to operate.

AUTOMOBILE NOTE.

THE AUTOMOBILE LAW OF NEW JERSEY—The automobile law of New Jersey, approved March 23, 1903, with annotations and forms of application for license, etc., has been issued and is being distributed with the compliments of the Automobile Club of New Jersey. The headquarters of the club is at 8 Central avenue, Newark, N. J. Briefly, the act starts with a definition of a motor vehicle. Registration is compulsory, and a declaration and statement is to be sent to the Hon. S. D. Dickinson, Secretary of State, Trenton, N. J., with a filing fee of $1. This applies to either residents of the state or to any non-resident of the state whose motor vehicle is driven within the confines of the state. This section does not apply to manufacturers or dealers in the state, except as to vehicles kept by the manufacturers or dealers for his private use or for hire. Each motor vehicle is to carry a license number, and during the period from one hour after sunset to one hour before sunrise, at least two lighted lamps, showing white lights visible at least 200 feet in the direction toward which the motor vehicle is proceeding, and at least one red light visible in the reverse direction. Upon the sides or fronts of the two lamps showing white lights there shall be displayed, in such a manner as to be plainly visible when the lamps are lighted, the number of the license issued by the Secretary of State, the same to be in separate Arabic numerals. A speed of one mile in six minutes can be made upon the sharp curves of a street or highway, and at the intersection of prominent cross roads; a speed of one mile in seven minutes where a street or highway passes through the built-up portion of a city; elsewhere, and except as provided in the above subdivisions, a speed of one mile in three minutes is the allotted time. Any person driving a motor vehicle, upon the request or upon the signal, by putting up the hand, or otherwise, from a person riding or driving a horse or horses in the opposite direction, shall cause his motor vehicle to stop and remain stationary so long as may be necessary to allow the horse or horses to pass. Racing is prohibited, and any police officer may, without a warrant, arrest any parties who violate this section.

LEGAL NOTE.

DECISION SUSTAINING BLADE'S PATENT—On March 26, Judge Kohlsaat, sitting in the United States Circuit Court, Northern District of Illinois, Northern Division, in suit No. 24,965, gave a decision sustaining Blade's patent No. 418,678, owned by the Cutler-Hammer Manufacturing Company, of Milwaukee, Wis.

ELECTRICAL SECURITIES.

In more than one direction there is the apparent evidence that liquidation has about run its term in market conditions. Although the financial district is more or less depressed, the national industrial condition is one of buoyancy, and although the many disturbing elements which have been manifested in the large cities have tended to show an unrest in the labor organizations, the moneyed interests are inclined to take an optimistic view of the market in general. During the early part of the week there was a slight rally in prices, due to the very high tone of the professional element, but this was only temporary, and brought more strongly in evidence the absolute apathy on the part of the buying public.

Several of the large industries closely connected with the electrical field have recently made substantial increases in their capitalization, and this, together with the buying of new properties, would seem to indicate that the outlook for the coming season is even more assuring than the great prosperity which has existed for the past several years.

ELECTRICAL SECURITIES FOR THE WEEK ENDING APRIL 4.

New York:	*Closing.*
Brooklyn Rapid Transit	67½
Consolidated Gas	205
General Electric	186
Kings County Electric	220
Manhattan Elevated	138⅛
Metropolitan Street Railway	133⅜
New York & New Jersey Telephone	164
Westinghouse Manufacturing Company	196

Boston:	*Closing.*
American Telephone and Telegraph	154½
Edison Electric Illuminating	265
Massachusetts Electric	90
New England Telephone	136
Western Telephone & Telegraph preferred	97½

The annual statement of the New England Telephone and Telegraph Company, dated December 31, 1902, shows total assets of $28,287,823, as compared with $24,930,753 for the year 1901. The net profits for 1902 are $1,356,470, as against $1,205,648 for the twelve months previous.

Philadelphia:	*Closing.*
Electric Company of America	8⅞
Electric Storage Battery common	78
Electric Storage Battery preferred	78
Philadelphia Electric	6¾
Union Traction	46¾
United Gas Improvement	108

Chicago:	*Closing.*
Chicago Telephone	150
Chicago Edison Light	155
Metropolitan Elevated preferred	78
National Carbon common	24¼
National Carbon preferred	98
Union Traction common	9¾
Union Traction preferred	40

Directors of the Chicago Edison Company will meet about April 15 to act on the matter of the regular quarterly dividend of 2 per cent, which is payable May 1. The company's fiscal year ended March 31, and it is said that the annual report, to be issued shortly, will be an improvement on last year. The annual meeting falls on June 8.

The Metropolitan Elevated annual report shows total income of $2,040,005, operating expenses of $952,707, and surplus earnings of $1,087,297. The balance to date, after dividends and charges, is $10,855. The average of passengers carried for March was 116,716, an increase of 11,204.

The South Side Elevated Company's daily average of passengers carried in March was 87,989, an increase of 7,676.

PERSONAL MENTION.

MR. SAMUEL INSULL, president of the Chicago Edison Company, after spending the last three months in a trip to England, has recently returned.

HON. W. M. CRANE has been elected president of the Stanley Electric Manufacturing Company, of Pittsfield, Mass. Dr. F. A. C. Perrine was elected vice-president.

MR. EDWARD R. KNOWLES, New York city, has been retained as the consulting electrical engineer for the American Type Founders Company's new factory at Communipaw, N. J.

DR. WALTHER NERNST, professor of physical chemistry at the University of Göttingen, Germany, arrived in New York on the Kaiser Wilhelm der Grosse, on April 1, from Bremen.

JUDGE J. M. THOMAS, president of the Independent Telephone Association of the United States, has been making a prolonged voyage in southern seas. Mr. Thomas has recently resumed his active duties at his New York office.

MR. FRANK MACGOVERN, of Rossiter, MacGovern & Company, New York, left on Saturday last for St. Louis and New Orleans. Mr. MacGovern will be away for a fortnight, looking after the large interests of his house in these two cities.

MR. CHARLES CUTTRISS, of New York, chief electrician of the Commercial Cable Company, started for the Philippine Islands on Saturday last where he will remain until the Pacific cable is completed to that point. Mr. Cuttriss will be absent several months.

MR. JOSEPH C. BATCHELOR, formerly with the Delaware & Hudson Railroad, has been elected treasurer of Rossiter, MacGovern & Company, Mr. Batchelor leaves many friends in railroad circles and will receive kindly welcome from many new ones in the electrical field.

MR. J. B. D'HOMERGUE, manager of the "Keystone Hair Insulator" department of the H. W. Johns-Manville Company, New York city, sailed on March 30 for England, where he will make an exhaustive and comprehensive investigation of the trade for asbestos and sound-deadening materials in that country. Upon his return, about May 1, he will be permanently located in New York.

MR. HUGH L. COOPER, who has had charge of repairing the Chambly dam for the Montreal Light, Heat and Power Company, has left for Mexico, where he will take up his work as resident engineer of the Mexican Light and Power Company. Mr. Cooper is in charge of the hydraulic works at Sao Paulo, and it is expected that work on the installations of the Mexican company will be similar to that at Sao Paulo.

MR. CHARLES F. SCOTT, president of the American Institute of Electrical Engineers, has an interesting article on "Alternating Current for Light and Power," in the current issue of *Cassier's Magazine*. This discusses in an instructive way the requirements of a system furnishing light and power, and shows how these are met by an alternating system, together with the advantages which this has as compared with other systems.

MR. JOHN C. BARCLAY, electrical engineer of the Western Union Telegraph Company, has been appointed assistant general manager of the company, and entered upon his duties April 1. Mr. Barclay was stationed at Chicago for several years, as electrical engineer of the western division of the company, and upon Colonel Clowry's succession to the presidency of the company removed to take up his headquarters in New York. Mr. Barclay has been in the employ of the Western Union Telegraph Company for the last twenty-five years.

PROFESSOR J. A. EWING, Cambridge, England, has been appointed to the new post of director of naval education, under the new plan of training which has been instituted for naval officers. Professor Ewing began engineering work as an assistant to Lord Kelvin and the late Professor Fleeming Jenkin. He has taken a prominent part in the Western, Brazilian and Platino-Brazileira cable expeditions. In 1878 he was appointed to the professorship of mechanical engineering at the University of Tokio, Japan, which he resigned in 1883 to become professor of engineering at University College, Dundee. Since November, 1890, he has been professor of applied mechanics and mechanism in the University of Cambridge.

MR. CHARLES J. GLIDDEN, Boston, Mass., the well-known telephone and telegraph financier, has gained more than usual fame as a long-distance automobile tourist. He has now appointed unto himself the task of piloting his vehicle very close to the Arctic circle. His plan for the coming summer is to leave New York about the middle of June, going direct to London, where he will secure a foreign machine now being constructed for him by the winner of the last James Gordon Bennett cup race. The start will be made from London on June 20, and the itinerary will pass through England and Wales, Ireland and Scotland, Norway and Sweden, Denmark, Germany and Holland, the total distance being about 4,500 miles. Mr. Glidden expects to make the trip in forty-five days.

ELECTRIC RAILWAYS.

KANSAS CITY, MO.—An electric car line, to connect St. Joseph with Kansas City, is being planned, it is said, by St. Joseph and Cleveland, Ohio, capitalists.

UTICA, N. Y.—Officials of the Utica & Mohawk Valley Railway Company announce that cars will be running to Little Falls by the latter part of April or early in May.

MOHAWK, N. Y.—Work has been begun on the Oneonta, Cooperstown & Richfield Springs Electric Railroad, and the road will probably be in running order by July 1.

ATLANTA, GA.—The Georgia Railway and Electric Company will, it is said, make additional improvements to one of its power stations. The work will cost about $15,000.

WEST CHESTER, PA.—The West Chester, Kennett Square & Wilmington Railway Company will extend its line from Kennett Square to Coatesville, *via* Unionville and Doe Run.

KANSAS CITY, MO.—The Metropolitan Street Railway Company will erect a new power-house, to cost $300,000. The building will have a frontage of 198 feet, and will be 268 feet deep. Work will begin immediately.

MILWAUKEE, WIS.—The Cincinnati, Milford & Loveland Traction Company has let the contract for the construction of its road between Cincinnati and Loveland, *via* Milford. The deal involves about $1,000,000, the road to be thirty-three and one-half miles in length. Work is to begin at once.

SALAMANCA, N. Y.—The Ellicottville, Mansfield & East Otto Railway Company has been organized to build a trolley line from Ellicottville to East Otto, passing through Mansfield. The capital stock is $250,000, and among those interested are A. B. Fancher, of Salamanca, and John S. Rockwell, of Buffalo.

PIERRE, S. DAK.—Articles of incorporation have been filed with the Secretary of State for the Black Hills & Spearfish Valley Electric Railway Company, at Spearfish, with a capital of $2,500,000. It is proposed to construct and operate an electric railway from Spearfish to Belle Fourche, and to Lead and Deadwood.

GREENWICH, CT.—The trolley line of the Greenwich Tramway Company, from Mianus to Sound Beach, has been opened. Connection is made with the Stamford trolley, and there is now only one break in continuous trolley service between New York and Boston, and that is on the other side of New Haven.

COSHOCTON, OHIO—The Capital City Traction Company, of Olympia, Wash., was organized recently. The officers elected are: President, J. B. Weddel, Mansfield; vice-president, J. B. Becket, Cincinnati; secretary, E. B. Connor, Coshocton; treasurer, A. S. Caton, Olympia, Wash. Among the directors are: W. E. Haycox, of Cleveland, and J. T. Morton, of Pittsburg.

AKRON, OHIO—At a meeting of the stockholders of the Akron-Alliance Electric Railway line held recently, the following officers were elected: President, R. D. Gibbey; vice-president, G. W. Major; secretary and treasurer, H. A. DeRaismes; assistant secretary and treasurer, Charles Keith; manager, Hugh Bleakley. The president of the road states that work will begin by May 1.

ALTOONA, PA.—The Tyrone Electric Railway, which has passed into the control of the American Railways Company system, will continue to be operated as the Tyrone Electric Railway, the reorganization of which is as follows: President, D. Shelley Kloss; vice-president, H. J. Cowley; secretary and treasurer, C. S. L. Tingley. Some of the curves on the line are to be eliminated, enabling the company to shorten the schedule running time.

STROUDSBURG, PA.—Articles of association have been filed for a new trolley company known as the Minsi Valley Street Railway Company, with a capital of $42,000. An electric railway will be built from Water Gap to Shawnee. F. W. Eilenberger is president of the company, and among the incorporators are Harvey Huffman, H. A. Croasdale, P. R. Johnson, J. I. Johnson, J. D. Brodhead, S. D. Overfield, C. Webster Eilenberger and Charles Shuman. It is thought that later connection will be made for Stroudsburg and East Stroudsburg.

NEW INCORPORATIONS.

KEOSAUQUA, IOWA—Electric Power Company. $10,000.

DES MOINES, IOWA—North Branch Telephone Company. $5,000.

RALEIGH, N. C.—The Teachey Bell Telephone Company. $5,000.

WASHINGTON, D. C.—The Mount Vernon Telephone Company. $5,000.

ST. LOUIS, MO.—Ardmore Electric Company. Increased to $25,000.

PENDLETON, IND.—Anderson & Fall Creek Telephone Company. $40,000.

COLUMBUS, OHIO—The Coleram Telephone Company. Increased to $10,000.

NASHVILLE, TENN.—The Knoxville Power Company. Increased to $100,000.

ROCHESTER, N. Y.—Rochester Gas and Electric Company. Increased from $4,300,000 to $5,000,000.

TRENTON, N. J.—Municipal General Electric Company. Increased from $1,000,000 to $2,500,000.

CINCINNATI, OHIO—Cincinnati, Milford & Loveland Traction Company. Increased from $700,000 to $1,000,000.

OMAHA, NEB.—The Silver Creek Telephone Company. $5,000. Incorporators: J. H. Pollard, Fred Johnston and J. F. Gagen.

DOVER, DEL.—Union Gas and Electric Company. $3,475,000. Incorporators: Henry C. Wood, Edward Clifford and M. Paul Myres.

CEDAR FALLS, IOWA—The Gorman Electric Company. $50,000. Directors: John Gorman, G. E. Gorman and George E. Budd.

INDIANAPOLIS, IND.—Columbia Electric Company. $50,000. Incorporators: Seymour Morrison, Frank M. Martindale and Luther R. Frost.

AUSTIN, TEX.—Oil Well, Light and Power Company. $40,000. Incorporators: J. G. Hamill, George E. White, M. H. Johnson and A. V. Stafford.

INDIANAPOLIS, IND.—Carlisle Cooperative Telephone Company. $10,000. Incorporators: John Whipps, Salathiel Boon and Charles Griffin.

LE MARS, IOWA—The Le Mars Telephone Company. $50,000. Incorporators: J. U. Sammis, A. C. Colledge, E. A. Dalton, E. Duke Naven, M. H. Breen.

INDIANAPOLIS, IND.—Fisher's Station & Oakland Telephone Company. $400,000. Directors: Charles A. Ringer, Robert J. Craig and Walter L. Northam.

WILLSHIRE, OHIO—The Willshire Telephone Company. $20,000. Incorporators: I. D. Johnson, P. W. Deitsch, Alex. Beall, Levi Young and Fred Young.

BLOOMFIELD, IND.—The New Home Telephone Company. $50,000. Incorporators: John F. Slinkard, of Bloomfield; Peter M. Stone and W. C. Bennett, of Scotland, and others.

INDIANAPOLIS, IND.—The Martinsville Light, Heat and Power Company. $100,000. Directors: G. P. Davis, Robert P. King, Merrill Moores, Lewis K. Davis and Clemens Blank.

OCEAN GROVE, N. J.—Jamesburg Electric Light, Heat and Power Company. $100,000. Incorporators: Henry Westerhoff and John Van Neida, of Ephrata, Pa., and Peter Westerhoff, Paterson.

TRENTON, N. J.—The Manila Railway and Light Company. $1,000,000. Incorporators: George C. Smith, of Pittsburg; Peter L. Kimberly and Frank H. Buhl, of Sharon, Pa.; Charles M. Swift, of Detroit; J. G. White, of New York, and Albert C. Wall, of Jersey City.

DENVER, COL.—Citizens' Automatic Telephone Company. $500,000. Incorporators: John C. Shields, F. F. Costelle, A. T. Gunnell, E. W. Giddings, A. G. Sharp, John A. Himebaugh, Frank G. Peck, C. L. Hemmings, D. V. Donaldson, J. Arthur Connell, Irving W. Bonbright.

ELECTRIC LIGHTING.

TERRYVILLE, CT.—The Bristol & Plainville Tramway Company has voted to extend its incandescent lighting system to this place.

WALLA WALLA, WASH.—The Walla Walla Gas and Electric Company will soon begin work on a 4,000-horse-power plant on the Walla Walla River.

PITTSBURG, PA.—The Manufacturers' Heat and Light Company, capitalized at $25,000,000, has been formed and will be established in Pittsburg.

BURLINGTON, IOWA—The Kewanee Light and Power Company will install within the next few months a plant costing between $40,000 and $45,000.

STROUDSBURG, PA.—The Monroe County Water Power and Supply Company, recently chartered, announces that it will begin at once the erection of a plant to cost $75,000.

BUTTE, MONT.—A report from Lewistown states that work upon a new electric light plant, to cost $25,000, will be commenced there at once. About 500 horse-power will be developed.

YOUNGSTOWN, OHIO—It is stated that the Youngstown & Ohio River Railway Company has decided to build its power-house at Teegarden, where an option has been secured on a site.

NASHVILLE, TENN.—A charter has been issued to the Chattanooga Electric Company, under the laws of New Jersey. The company is to operate in Chattanooga, Tenn., making use of electricity in its various forms.

NIAGARA FALLS, N. Y.—It is stated that the Niagara & Toronto Power Company will apply for permission to increase its capital from $3,000,000 to $6,000,000, and to increase its bonding power from $1,500,000 to $5,000,000.

SODUS, N. Y.—It is stated that an electric light plant will be built in Sodus some time during the summer, sufficient lights having been subscribed for to warrant the undertaking. Bert H. Shepard, of Syracuse, is the promoter.

TORONTO, ONTARIO—The Erie-Ontario Power Company has applied for a charter to operate in Ontario. The water course and railway will run from, at or near the mouth of the Grand River northerly to a suitable point on Lake Ontario.

MARINETTE, WIS.—A power plant is to be built at Chandler Falls, on the Escanaba River, the power to be transmitted to Wells and Escanaba. The cost of the dam is estimated at $30,000, and the complete plant will cost in the neighborhood of $200,000.

MONTREAL, QUEBEC—The Montreal Light, Heat and Power Company has purchased the St. Lawrence Power Company, which controlled the power rights of the Soulanges Canal, from which point it was proposed to develop power to the extent of 40,000 horse, if necessary.

MANHATTAN, KAN.—The members of the Manhattan Electric Light Company met recently and incorporated under the name of the Manhattan Ice, Light and Power Company. The directors for the coming year are: C. P. Dewey, president; H. P. Wareham, vice-president; F. B. Elliott, secretary; Charles T. Killen, treasurer, and H. J. Barnhouse.

GRAND RAPIDS, MICH.—The Springfield (Ill.) Railway and Light Company has been reorganized through the efforts of H. D. Walbridge and Antrim G. Hodenpyle, of this city. The total authorized issue of securities is $5,000,000, and it is understood that the sum has been largely oversubscribed. Considerable local capital has been invested in the company.

DOVER, ME.—At the recent annual meeting of the stockholders of the Dover & Foxcroft Light and Heat Company, C. C. Hall, Wainwright Cushing, James Bathgate, George E. Howard and L. P. Evans were reelected directors. The directors elected are: C. C. Hall, president; Dr. E. A. Thompson, treasurer; F. E. Guernsey, attorney. The company is in a prosperous condition.

PITTSBURG, PA.—The Pittsburg Railways Company has completed the award of practically all contracts for the equipment of its power plant on Brunots Island, for which the building is now under construction. The total cost of the equipment will be more than $1,500,000. Another item in connection with the construction of the power-house will be the construction of new feeder lines. These, it is estimated, will cost about $650,000.

INDUSTRIAL ITEMS.

BUSHEY & HANLEY are the proprietors of the new electric dry dock at West New Brighton, S. I. This has a capacity of 700 tons and a length of keel of 165 feet, and has all the modern equipments and paraphernalia necessary for the proper docking and repairing of vessels of this size.

THE PITTSBURGH TRANSFORMER COMPANY, Pittsburg, Pa., has just printed an attractive pamphlet descriptive of Pittsburg transformers. This shows several parts of the transformer, and supplements half-tones with a brief description. This will be sent on request to the company.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has compiled a set of advertising slips showing the different adaptations which may be secured by the use of the Emerson automatic start induction motor in different classes of work. This will be sent to those interested on application.

THE C. W. HUNT COMPANY, West New Brighton, N. Y., is distributing a new catalogue descriptive of electric hoists for manilla or wire rope. This describes and illustrates a number of typical installations of electric motors operating special forms of hoists. This bulletin will be sent upon application.

THE DULUTH STOKER COMPANY, Duluth, Minn., is at present equipping ten steamships with its Duluth stoker. The claim for this mechanical stoker is that smokeless combustion is obtained by its use. The operation involves some novel features, and the apparatus is being built in several large sizes for stationary work.

THE GARVIN MACHINE COMPANY, Spring and Varick streets, New York city, has just printed a valuable catalogue descriptive of its milling machines. This shows in half-tone and diagram illustrations the assembly and operation of milling machine adjustments. This catalogue will be sent to machine tool users on request.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., has had to considerably extend its warehouse room in order to handle the rubber-covered wire business which has developed. This company's stock is made up of every style and kind of wire, and is of sufficient magnitude that the largest or smallest order may be handled promptly.

THE UNION SWITCH AND SIGNAL COMPANY, Swissvale, Pa., has secured the contract for one of the largest interlocking installations in the country. This is for the St. Louis terminal. The Westinghouse electropneumatic system will be adopted, and the contract calls for 258 working levers, with fifty-one spare levers, which will perform 748 functions.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, through its Montana office, has sold to the Bismarck Nugget Gulch Consolidated Mining Company a complete power equipment, consisting of inductor alternators, induction motors, hot wire voltmeters and ammeters, lightning arresters, and the attendant controlling and regulating apparatus.

THE GRAY TELEPHONE PAY STATION COMPANY, Hartford, Ct., is placing on the market a new line of pay station equipment. The apparatus now manufactured by this company covers every application to which pay station service can be adapted. An illustrated catalogue will be sent to any one on request. Mr. Ellis B. Baker, at 253 Broadway, is the New York agent.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, Ill., has received an order from the Delaware County Telephone Company, of Manchaster, Iowa, for an automatic switchboard of 1,000 capacity, with a present installation of 300 lines. Manchester has had an automatic telephone service for seven years, the company being one of the earliest purchasers of automatic apparatus. The business has outgrown the ultimate capacity of the board now in use, and the new equipment has been purchased to meet the increasing demands for service.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY recently closed contracts for switchboards with the Bergholz Telephone Company, Bergholz, Ohio, and Winona Telephone Company, Winona, Ohio. The following companies have also purchased equipments from the Stromberg-Carlson company: Wataga Mutual Telephone Company, Wataga, Ill.; Gays Mutual Telephone Company, Gays, Ill.; Cullom Mutual Telephone Com-

pany, Cullom, Ill.; Fairbury Farmers' Telephone Company, Fairbury, Ill.; Millikan & Stokes Telephone Company, Edinburg, Ill.; Central Illinois Telephone and Telegraph Company, Lincoln, Ill., and Farmers' Mutual Telephone Company, Ashmore, Ill.

MESSRS. DODGE & DAY, Philadelphia, Pa., have been commissioned to report on a motor equipment for the Firth-Sterling Steel Company, Pittsburg, Pa.

THE W. J. BARR MANUFACTURING COMPANY, Cleveland, Ohio, has just been incorporated with a capital stock of $10,000, fully paid up. Thomas E. Barr is general manager, and W. J. Barr is president and treasurer. The company has taken over the business of Mr. W. J. Barr, and, as before, will manufacture transmitter arms exclusively.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, in its April calendar card of the great men of science and engineering series, illustrates and gives a biographical sketch of Sir Charles Lyall. The company is in a strong position, with increased facilities—embracing new shops and new tools—to give prompt deliveries, and solicits specifications for both large and small machines.

THE LYON METALLIC MANUFACTURING COMPANY, 137 Fulton street, Chicago, Ill., maker of sheet metal specialties, will quote prices on all kinds of metal work. A new catalogue which the company has just issued will be sent gratuitously on request. This company carries in stock a large variety of boxes. On April 20 the company will remove to its new building at 18 and 20 South Ann street, Chicago, Ill.

THE COMMERCIAL ELECTRICAL SUPPLY COMPANY, 1007 and 1009 Market street, St. Louis, Mo., has recently increased its working force and its warehouse capacity, and is in a position to handle a largely increased trade, and keep its stock at all times up to the latest requirements of the Board of Fire Underwriters. Among the prominent apparatus for which this company is the selling agent are the Nernst lamp, the Duncan wattmeter, Peerless transformer, and "O. K." weather-proof and slow-burning wire.

THE STILWELL-BIERCE & SMITH-VAILE COMPANY, with headquarters at Dayton, Ohio, has established a branch office in San Francisco, at 11 and 13 First street. The pumping machinery and air compressor department of that office will be looked after by Mr. George W. Ingils, and the turbine water-wheel department by Mr. E. G. De Wald. Mr. De Wald is one of the assistant engineers of the company, and last year made several trips to California, closing a number of orders for turbine work for high heads.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., has secured a contract from Albert Schwill & Company, Chicago, aggregating over 600 kilowatts in generators, and over 1,000 horse-power in motors. The Western company has also received an order from the Danville Street Railway and Light Company, of Danville, Ill., for three 100-kilowatt, 150 revolutions per minute generators. This company's railway generators are gaining favor throughout the country, and in consequence of this a number of contracts is being awarded for this apparatus.

HARVEY HUBBELL, Bridgeport, Ct., has produced a very striking panel illustrating special finishes of the Hubbell sockets and clusters. On the circumference of a circle in the centre of the card, sections of metal sockets representing the following finishes are placed: Nickel plate, Butler silver, old brass, old English bronze, mottled copper, oxidized copper, wrought iron, polished brass and rich gilt. The Hubbell sockets and clusters are made in a number of other finishes, but those shown on this panel are a sufficient evidence of the elegant appearance of this material.

THE WARREN ELECTRIC MANUFACTURING COMPANY, Sandusky, Ohio, manufacturer of the celebrated Warren alternator, is distributing an attractive bulletin descriptive of this machine. The Warren alternator is illustrated in several sizes, and a description is given of the essential parts of the apparatus, which is extremely simple. A large double-page half-tone shows a Warren alternator direct-coupled to a steam engine, and illustrating the method of connecting the circuits to the terminal board on the base of the machine. Besides the dimensions and other characteristics of the standard belt-driven alternator, there are a number of testimonials from users of this apparatus.

THE EWING MERKLE COMPANY, St. Louis, Mo., has closed agency arrangements for the exclusive selling in the territory west of the Mississippi of Commercial direct-current dynamos and motors, Jandus arc lamps, and Bryan-Marsh incandescent lamps, and now has under consideration propositions from a number of factories for a complete line of specialties. The Ewing-Merkle Company has been in business but a short time, but owing to the large force of salesmen on the road and the agreements which are being made, the business received has been eminently satisfactory, and the company is sanguine over the prospects for a very good year.

THE HEMINGRAY GLASS COMPANY, Covington, Ky., with factories at Muncie, Ind., recently received the following letter from the Missouri River Power Company at Helena, Mont., written by M. H. Gerry, Jr., general manager, which is a remarkable tribute to the excellence of the company's type of insulator: "We are at present running the highest voltage in commercial circles, and are carrying a very large and important load, at a distance of sixty-five miles from our power-house, with practically no line trouble whatsoever. These high-voltage transmission lines are equipped entirely with your insulators, and are giving excellent satisfaction, and are demonstrating daily the practicability of transmitting power at voltages of 55,000 and over."

THE JOHN F. KELLY ENGINEERING COMPANY has been established, with headquarters in the Singer Building, 149 Broadway, New York city. This company will do a general consulting and contracting engineering business. The members are as follows: John F. Kelly, Ph. D., president and consulting engineer; W. L. Fairchild, vice-president and secretary; T. W. Kloman, treasurer and manager. Mr. Fairchild and Mr. Kloman have been associated with Mr. Kelly in the Stanley Electric Manufacturing Company, of Pittsfield, Mass., Mr. Kloman having been but recently acting as manager of the New York office and Mr. Fairchild as sales engineer. These gentlemen form a strong combination of engineering ability and business experience, and the firm is well fitted to undertake any sort of proposition.

THE ENGINEERING AGENCY, 1208 Monadnock Block, Chicago, Ill., was started in 1893 by F. A. Peckham, at that time western manager of the *Engineering News*. Mr. Peckham's experience had assured him that an agency whereby first-class technical men and employers could have a mutual bureau of information would be a great practical success. The agency has grown steadily during the past ten years, and has secured positions for over 5,000 technical men. The registrations during the past two years have exceeded 3,000, and it is said that the agency has difficulty, even under these conditions, in securing enough competent men to supply all the demands made upon it by companies wishing high-grade help. The registrations are made under the severest conditions of investigation. Mr. F. A. Peckham is president of the agency; Mr. A. B. Gilbert is treasurer, and Mr. A. G. Frost is secretary.

THE LOMBARD GOVERNOR COMPANY, Boston, Mass., reports that the demand is good for its high-grade water-wheel governors. The company has recently closed the following orders: Cascade Electric Company, of Berlin, one type B governor; Redlands Electric Light and Power Company, of California, one type F governor; Brattleboro Gas Light Company, Brattleboro, Vt., one type O governor; Ware Shoals Manufacturing Company, Laurens, S. C., two type B governors and four hydraulically balanced relief valves; Nasonville Woolen Company, Nasonville, R. I., one type D governor; Athens Electric Railway Company, Athens, Ga., one type D governor; Ludlow Manufacturing Associates, Ludlow, Mass., one type D governor; Sebasticook Power Company, Sebasticook, Me., three type D governors; Niagara Falls Power Company, Niagara Falls, N. Y., one type G governor; Lynchburg Water Power Company, Lynchburg, Va., two type B governors, two type P governors, and four electric speed controllers; Public Works Company, Bangor, Me., two type B governors, with electric speed controllers; Zanesville Electric Light and Power Company, Zanesville, Ohio, two type B governors with electric speed controllers; Canadian Electric Light Company, Levis, Quebec, one type B governor; Victor M. Braschi & Brother, City of Mexico, one type F governor; Sacramento Electric, Gas and Railway Company, one type B governor, and electric speed controller; Valley Counties' Power Company, of California, two type D governors, with electric speed controllers.